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BOTANY
ALL THE
YEAR ROUND
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BOTANY ALL THE YEAR ROUND

A PRACTICAL TEXT-BOOK FOR SCHOOLS

BY

E. F. ANDREWS

HIGH SCHOOL, WASHINGTON, GEORGIA

4

A Brief Course of the Eastern
United States

W. Nevin Geddes, B.S., Ph.D.

Page - 3

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E. F. ANDREWS.

ENTERED AT STATIONERS' HALL, LONDON.

ANDREWS'S BOTANY.

W. P. 7

PREFACE

MOST of the recent text-books of botany, excellent as many of them are, fail to meet the conditions of the average public school, where expensive laboratory appliances are out of the question, and time to make a proper use of them is equally unattainable. It is one of the anomalies of our educational system that the study of plants, if provided for at all, should be confined mainly to city schools, where it is necessarily carried on under disadvantageous conditions, while it is almost entirely neglected in the country, where the great laboratory of nature stands invitingly open at every schoolhouse door.

The writer believes that this neglect is largely due to the want of a text-book suited to general use, in which the subject is treated in a manner at once simple, practical, and scientific. It is with a desire to meet this need and to encourage a more general adoption of botanical studies in the public schools that the present work has been undertaken. It aims, in the first place, to lead the pupil to nature for the objects of each lesson; and in the second place, to provide that the proper material shall be always available by so arranging the lessons that each subject will be taken up at just the time of the year when the material for it is most abundant. In this way the study can be carried on all the year round, a plan which will be found much better than crowding the whole course into a few weeks of the spring term.

In order to provide for this all the year round course it has been necessary to depart somewhat from the usual order of arrangement, but years of experience have convinced the writer that the advantages to be gained by having fresh

material always at hand are sufficient to outweigh other considerations that might be advanced in favor of established methods. The leaf has been selected as the starting point mainly because it is the most convenient material at hand in September, when the schools begin; and it is such an important and fundamental part of the plant that a thorough acquaintance with its nature and functions will clear the way to an understanding of many of the problems that will face the student later.

It is not expected that all the work outlined in the book will be done just as it is written, and much of it may even have to be omitted altogether. Each teacher can select such parts as are suited to the circumstances of his school, passing lightly over some topics, giving more attention to others, as material and opportunity may suggest. The study of botany is necessarily sectional to some extent, because nature is so, but the method here outlined is of universal application and every teacher can select his own specimens in accordance with the directions given in the body of the book. Prominence is given to the more familiar forms of vegetation presented by the seed-bearing plants, as the author believes that for ordinary purposes the best results are to be obtained by proceeding from the familiar and well known to the more primitive and obscure forms. The reverse order may be better for the trained investigator; the other is simpler and more attractive, and for ordinary purposes the only practicable one. The average boy and girl will learn more of what it concerns them to know about stem structure, for instance, from a cornstalk, and a handful of chips, or even from the graining of the timber out of which their desks are made, than from the most elaborate study of the *xylem* and the *phloem* and the *collenchymatous tissues*. For we must bear in mind that the object of teaching botany in the common schools is not to train experts and investigators but intelligent observers.

In giving the botanical names of plants the terminology of Gray's handbooks is adhered to, partly because they

are at present the most generally available for school use, and more especially because the new terminology is in such an unsettled state that nobody can say what it will be to-morrow or next day. Hence, while recognizing the desirability of some of the changes proposed, the author does not think it advisable to confuse the beginner by introducing him to a system that is undergoing a period of transition. After all, this is a mere matter of names, and does not affect the point that ought to be kept in view — the hereditary relationships of plants.

The experiments described are for the most part very simple, requiring no appliances but such as the ingenuity of the teacher and pupils can easily devise, as will be seen by a glance at the list on pages 12 and 13 of the text.

Teachers trained in normal schools, where all the material needed for their work is furnished by the State, and ample time allowed them, are often completely at a loss when transferred to country schools, where no provision is made for laboratory work, and the patrons grumble if called upon to buy so much as a drawing book or a hand lens. Too often they can think of no other resource than to drop botany from the curriculum altogether rather than depart from what they have been taught to consider the only scientific method. It is hoped that the present volume may suggest a better way out of the difficulty, and also that it may be a help to those who have not enjoyed the advantage of a technical training.

The writer would not underrate the value of histological studies or the advantages of a well equipped laboratory, but since these are at present clearly out of the reach of the great majority of the school population, and more especially of that very class to whom the study of plants is of the greatest practical importance and into whose lives it would bring the greatest amount of pleasure and of intellectual enlargement, it has been made the aim of this book to show that botany can be taught to some purpose by means within the reach of everybody. It has also been the author's aim to keep constantly in view the

intimate relations between botany and agriculture. The practical questions at the end of each section, it is hoped, will have the effect of bringing out these relations more clearly and at the same time of leading the pupil to reason for himself and draw his own inferences from the common phenomena about him.

The author takes pleasure in acknowledging here the many obligations due to Dr. C. O. Townsend of the United States Department of Agriculture for his very effective assistance in revising the manuscript of this work; also to Professor Charles Wright Dodge of the University of Rochester, and Professor W. F. Ganong of Smith College for valuable criticisms and suggestions. Acknowledgments are also due to Messrs. D. Appleton and Company, for permission to use illustrations from Coulter's "Plant Relations" and "Plant Structures," copyright, 1899, and to the owners of Gray's Botanies, to Professor William Trelease of the Missouri Botanical Garden, to Mr. Gifford Pinchot of the United States Department of Agriculture, and to Mr. W. S. Bailey of the Chautauqua Bureau of Publication, for permission to reproduce illustrations from their publications. Quite a number of the figures used are from original drawings by pupils of the Washington, Ga., High School.

CONTENTS

	PAGE
I. INTRODUCTION	9
II. THE LEAF: ITS USES—Transpiration; Respiration and Food Production; The Typical Leaf and its Parts; Veining; Branched Leaves; Phyllotaxy, or Leaf Arrangement; Leaf Adjustment; Transformations of Leaves; Field Work	15
III. FRUITS—Fleshy Fruits; Dry Fruits; Dehiscent Fruits; Accessory, Aggregate, and Collective Fruits; Field Work	63
IV. SEEDS AND SEEDLINGS—Monocotyledons and Polycotyledons; Dicotyledons; Forms and Growth of Seed; Germination; Seedlings; Growth; Field Work	87
V. ROOTS AND UNDERGROUND STEMS—Function and Structure of Roots; Fleshy Roots; Sub-aërial Roots; Underground Stems; Plant Food; Field Work	120
VI. THE STEM PROPER—Stem Forms and Uses; Stems of Monocotyledons; Stems of Dicotyledons; Movement of Water through the Stem; Wood Structure; Field Work	142
VII. BUDS AND BRANCHES—Branching Stems; Buds; Inflorescence; Field Work	173
VIII. THE FLOWER—Hypogynous Monocotyledons; Epigynous Monocotyledons; Dicotyledons; The Corolla; Suppressions, Alterations, and Appendages; Nature and Office of the Flower; Pollination; Field Work	196
IX. ECOLOGY—Ecological Factors; Plant Societies; Field Work	237

	PAGE
X. SEEDLESS PLANTS—Their Place in Nature ; Fern Plants ;	
Study of a Bryophyte ; The Algæ	250
XI. FUNGI—Their Classification ; Mushrooms ; Rusts ; Field	
Work	271
SYSTEMATIC BOTANY	286
APPENDIX	289
INDEX	297

BOTANY ALL THE YEAR ROUND



I. INTRODUCTION

1. General Statement.— Botany is the science which treats of the vegetable kingdom, but the subject is so comprehensive that it has been divided into many branches, each of which is a science in itself. For instance, there are Mycology, the study of mushrooms and other fungi; Bacteriology, the study of the microscopic forms concerned in the process of fermentation, and in the production of disease; Paleobotany, the study of fossil plants—and many others, with which we have no concern at present. Each of these studies may be viewed under various aspects, and these in turn have given rise to still other divisions of the subject, such as, —

2. Morphology, or Structural Botany, the study of the different organs or parts of plants in regard to their form and uses and the various changes and adaptations they may undergo.

3. Histology, or Plant Anatomy, the microscopic study of the minute structure of plant organs. This can not be carried on well without the use of the compound microscope and other appliances not obtainable in many schools. Something, however, may be learned from a few simple experiments, accompanied by intelligent observation with a hand lens, and it is only in so far as it can be carried on by ordinary means like these, that this branch of the subject is touched upon in the present work.

4. Vegetable Physiology, the study of the action of living plants and their organs, their mode of growth and reproduction, and their various movements for adjustment to their surroundings, as the attraction of roots toward moisture and of leaves toward light.

5. Ecology, the study of plants in their relations to external conditions, or, to use a more convenient term, their environment. This is one of the most interesting and important of all the departments of botany, and presents many points of direct practical concern to the farmer.

6. Taxonomy, called also Systematic or Descriptive Botany, the study of plants in their relationships to one another. Its work is to note their resemblances and differences, and by means of these to classify or distribute them into certain great groups called families or orders, and these again into lesser groups of genera and species. This work of classification was formerly considered the chief end of the study of botany, which thus too often degenerated into a mere mechanical drill in hunting down plants and labeling them with hard names. The tendency at present is to ignore this part of the subject altogether, which is nearly as great a mistake as the old-fashioned error of thinking that the study of botany consisted merely in learning a string of hard words. One of the chief pleasures to be derived from botanical studies, for most of us, consists in being able to know and recognize the various plants we meet with. The first thing we all ask on seeing a new shrub or flower is, "What is it?" and this question can be answered satisfactorily only by referring each to its proper class or order.

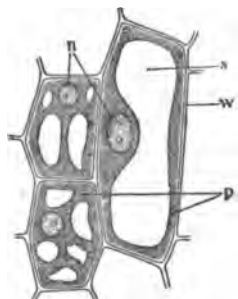
7. Learn to know the Common Plants.—These five subdivisions make up the study of botany, as generally taught in the schools. They apply to all plants, and the only practicable way for most of us to learn them is by a study of the common vegetable life about us.

8. Definitions.—“Organ” is a general name for any part of a living thing, whether animal or vegetable, set apart to do a certain work, as the heart for pumping blood, the lungs for breathing, or the stem and leaves of a plant for conveying and digesting the sap. By “function” is meant the work or office that an organ has to perform.

9. The Cell.—In its strictly scientific sense this word is applied to the smallest portions of organized matter that go to make up a living body, whether vegetable or animal.

It usually consists of a tiny membranous sac lined with a living semifluid substance called *protoplasm*, which ordinarily has one portion of denser consistency than the rest, called the *nucleus*. Within the protoplasmic lining are contained various watery fluids known as cell sap. These little sacs are packed together to build up the vegetable or animal structure as bricks are in building a wall. They are of various sizes and shapes. The containing membrane is called the cell wall. Cells can exist, however, without any wall, as mere specks or globules of protoplasm, but these are not common in vegetable structures. The essential part of every cell is the protoplasm with its nucleus. This substance, so far as we know at present, constitutes the physical basis of all life, and if the protoplasm loses its vitality, the cell dies and can no longer perform its functions of absorbing and retaining liquids. Slice a fresh beet in a vessel of water and a boiled one in another; how is the liquid affected in each? Account for the difference.

The name “cell” is also applied to the compartments into which the fruits and seed vessels of many plants are divided. This double meaning of an important term is unfortunate, but the context will always show in which sense it is to be taken, so that no confusion need result.



1. — Typical cells: *n*, nucleus; *p*, protoplasm; *w*, cell wall; *s*, sap.

10. Tissue is a term used to denote any animal or vegetable substance that is composed of a particular kind of material and that performs a particular office or function. Thus, for instance, we have bony tissue and muscular tissue in animals; that is, tissue made of bone substance and of muscle substance and doing the work of bone and muscle respectively. So in plants, we have woody tissue, or tissue made of woody substance, and vascular tissue, or tissue made up of little conducting vessels, which have their especial functions to perform.

11. Appliances needed for General Use.—The only appliances necessary for the study of this book, besides the material furnished by the woods and fields about us, are so few and simple that there can be no difficulty in providing them. The following list comprises about all that are essential:—

Half a dozen glass jars; preserve jars or wide-mouthed bottles will answer.

Half a dozen soup plates or other shallow dishes for germinators.

Some good-sized bits of window glass for covering jars and dishes.

A garden trowel.

A good hatchet for use when the study of timber is taken up.

A very sharp knife—a razor is better, if it can be obtained—for making sections.

A small whetstone for sharpening knives.

A vial of tincture of iodine.

A pint of red ink; or, if preferred, a good coloring fluid can be made by purchasing an ounce or two of eosin from the druggist and mixing it with water.

A pot of photograph paste.

If a yard or two of India rubber tubing, a common bulb thermometer, and a pair of druggist's scales are added to the above list, the number of experiments that can be performed will be considerably increased.

12. Appliances for Individual Use.—In addition to the general outfit for the school, each pupil should be provided with—

A good penknife.

A drawing book (or drawing paper) and a blank book for taking notes.

A book for dried specimens, made by sewing together two or three sheets of unsized paper, such as newspapers are printed on; this can be purchased from a printer.

Two well-pointed pencils, one hard, the other medium.

A pair of dissecting needles; wax-headed steel pins will do, but better ones can be made by running the heads of ordinary sewing needles into handles of soft wood and gluing them in.

Two bits of glass, not larger than a visiting card, as thin and clear as can be obtained, for inclosing specimens that must be held up to the light for examination. The glass plates sold for photograph negatives serve well for this purpose.

A good hand lens. The glasses known as "linen testers" can be purchased for twenty-five cents apiece, and make very good magnifiers.

A special place ought to be provided in the schoolroom for storing all these articles, and the strictest order exacted in the care of them. They should always be ready when wanted, and never used for any other purpose.

13. Living Material.—A number of potted plants should always be kept in the schoolroom, especially in cities, for observation and experiment. Among those recommended for this purpose are the following:—

One or two ferns.

A calla lily, or other arum.

A young India rubber tree (*Ficus elastica*).

A pot of "wandering Jew" (*Zebrina pendula*). The plain, green-leaved varieties are best.

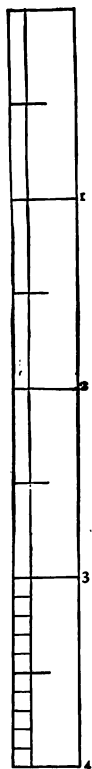
Some kind of prickly cactus. The common prickly pear (*Opuntia*) and the Mamillaria make good specimens.

A sedge; the umbrella plant (*Cyperus alternifolius*) or the Egyptian paper plant (*C. Papyrus*), so common in greenhouses, will either of them do very well, though our native wild plants are always preferable when they can be obtained.

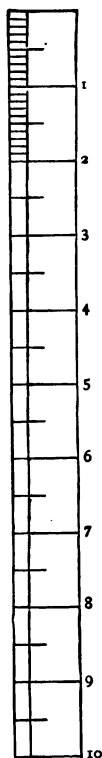
Healthy plants of oxalis and tropæolum.

A twining vine; hop, morning glory, kidney bean, etc.

A glass jar with one or two water plants, such as pondweed (*Potamogeton*), hornwort (*Ceratophyllum*), bladderwort (*Utricularia*), or pickerel weed (*Pontederia*), etc.

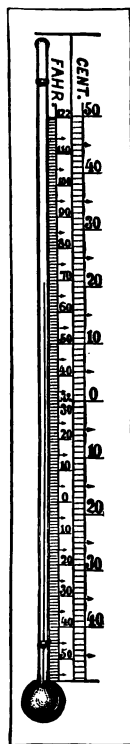


ENGLISH SCALE,
FOUR INCHES



METRIC SCALE,
TEN CENTIMETERS

2.—A comparative scale of the English and metric systems of length measure. One decimeter = 10 centimeters = 100 millimeters = approximately 4 inches.



3.—A comparative scale of the Centigrade and Fahrenheit thermometers. On the Centigrade scale 0 = the temperature of melting ice, and 100° = that of boiling water.

II. THE LEAF: ITS USES

TRANSPIRATION

MATERIAL. — Freshly cut sprigs of various kinds, bearing healthy leaves; a leaf of the white garden lily (*L. candidum*) or of the wandering Jew (*Zebrina pendula*); two hermetically sealing preserve jars; a little beeswax or tin foil; a bit of looking glass; a number of empty bottles with perforated stoppers or rubber cloth covers.

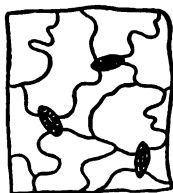
NOTE. — In order to avoid cumbering the pages of the text with technical nomenclature, botanical names of specimens mentioned will be given only: First, in the case of foreign or little known species; Second, where the popular name is local or provincial, or where the same term is applied to several different plants; and Third, where special accuracy of designation is required.

14. Why Leaves wither. — Dry two self-sealing jars thoroughly, by holding them over a stove or a lighted lamp for a short time to prevent their "sweating." Place in one a freshly cut leafy sprig of any kind, leaving the other empty. Seal both jars and set them in the shade. Place beside them, but without covering of any kind, a twig similar to the one in the jar. Both twigs should have been cut at the same time, and their cut ends covered with wax or vaseline, to prevent access of air. At the end of six or eight hours look to see if there is any moisture deposited on the inside of either jar. If there is none, set them both in a refrigerator or other cool place, for half an hour, and then examine them again. On which jar is there a greater deposit of dew? How do you account for it? Take the twig out of the jar and compare its leaves with those of the one left outside; which have withered most, and why?

15. Transpiration. — We learn from experiments like the foregoing that one office of leaves is *transpiration*, or

the giving off of moisture, just as animals do through the pores of the skin.¹ Now, we all know what happens to us if the perspiration glands of our body get stopped up, and hence we need not be surprised if hedgerows can not be kept vigorous and healthy by dusty roadsides, nor if even sturdy trees and shrubs take on a sickly look when the summer rain delays too long to give them their accustomed bath.

16. Stomata.—The transpiration pores of leaves are called *stomata* (sing. *stoma*) from a Greek word meaning "mouths." Generally they are too small to be seen without a compound microscope, but their presence can be made manifest by a simple experiment. Place a bit of looking glass against your cheek or your arm on a warm day, and it will soon be covered with a film of moisture from the skin. Next, place the glass in contact with the under side of a healthy growing leaf for thirty to forty-five minutes, and see if you can detect any moisture on it. The deposit will probably be fainter than that from the skin, but the presence of any at all will show that the leaf transpires.



4.—Portion of the epidermis of the garden balsam, highly magnified, showing the very sinuous walled epidermis cells and three stomata (after GRAY).

There are a few plants, such as the white lily of the gardens (*L. candidum*) and the wandering Jew, in which the stomata are large enough to be seen with a hand lens.

The common iris also shows them, though not so distinctly. Strip off from the under side of such a leaf a portion of the



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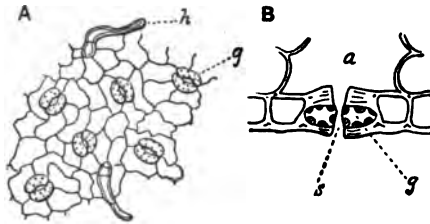
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5, 6.—Stomata of white lily leaf: 5, closed; 6, open (GRAY).

epidermis, or outer covering. Place it between two bits of glass with the outside uppermost, and

¹ Transpiration, though similar in external effects to the perspiration of animals, must not be confounded with it, as the two functions are physiologically quite different.

examine it with a good lens. Hundreds of little eye-shaped dots will be seen covering the surface, which can easily be recognized, by comparison with the accompanying Figures, as stomata. Examine a portion of the epidermis from the upper side of the leaf; are the stomata distributed equally on both sides, and if not, on which are they thickest? Which side of the epidermis seems to be most active in the work of transpiration?



7.—Stomata of an oak leaf: A, a small piece (highly magnified) of under epidermis removed to show stomata, *g*, and minute hairs, *h*. B, a stoma in vertical median section, cut at right angles to its longer axis; *a*, intercellular space; *g*, guard cell; *s*, orifice of stoma.

17. Distribution of Stomata.—While stomata are generally most abundant on the under side of leaves, where they are protected from excessive light and heat, this is not always the case. Similar openings occur also on young stems, and are called *lenticels*. In vertical leaves, like those of the iris, which have both sides equally exposed to the sun, stomata are distributed equally on both sides. In plants like the water lily, where the under surface lies upon the water, making transpiration in that direction impossible, they occur only on the upper side. Succulent leaves, as a general thing, have very few, because they need to conserve all their moisture. Submerged leaves have none at all; can you tell why?

18. Protection of Stomata.—In addition to their function of transpiration, stomata permit the entrance to the interior of the plant of atmospheric air containing carbon dioxide, a gaseous substance used by them in the formation of food. If they become choked up with water or other obstruction, the leaves can neither exhale their superfluous moisture nor take in air; hence these pores are protected by hairs, wax, and other water-shedding appendages. Plunge

a sprig of the dwarf St. John's-wort (*Hypericum mutilum*) or of wandering Jew into water and notice the silvery appearance of the leaves, especially on the under side. In the iris it is the same on both sides; why? Remove the sprig from the water, and the leaves will be perfectly dry. In the wandering Jew, as may be seen with a good hand lens, this is due to the air imprisoned by little membranous appendages which surround the stomata and prevent the water from entering. In other cases, as cabbage, hypericum, etc., a coating of wax protects the transpiration pores, and it is the reflection of the light from the air entangled in these protective coverings that gives the leaves their silvery appearance under water.

19. Amount of Transpiration.— Few people have any idea of the enormous amount of water given off by leaves. It has been calculated¹ that an oak may have 700,000 leaves and that 111,225 kilograms of water (about 244,695 lbs.) may pass from its surface in the five active months from June to October, and 226 times its own weight of water may pass through it in a year. If this seems an extravagant estimate, we can easily make one for ourselves.

Fill three bottles with water, and cover them tightly with rubber cloth to prevent evaporation. Mark the point at which the water stands in the bottles, make a small puncture through the covers, and insert into one bottle the end of a healthy twig of peach or cherry, into the second a twig of catalpa, grape, or any other large-leaved plant, and into the third, one of magnolia, holly, or other thick, tough-leaved evergreen, letting the stems of all reach down well into the water. Care must be taken to select twigs of the same age, as the absorbent properties of very young stems are more injured by cutting and exposure than those of older ones. All the specimens should be cut under water if possible, as even an instant's exposure to the air will greatly diminish the activity of the cut surface. Peach

¹ See Marshall Ward, "The Oak."

Is an excellent plant to experiment with, as its woody twigs are not greatly affected by cutting, and it absorbs water almost as rapidly as it transpires. At the end of twenty-four hours note the quantity of liquid that has disappeared from each glass. This will represent approximately the amount absorbed by the leaves from the twigs to replace that lost by transpiration. Which twig has transpired most? Which least? Note the condition of the leaves on the different twigs; have they all absorbed water as rapidly as they have lost it? How do you know this? Pluck the leaves from each twig, one by one, lay them on a flat surface that has been previously measured off by the aid of a rule, into a square of about thirty centimeters (twelve inches) to a side, containing nine hundred square centimeters (one hundred forty-four square inches), and thus form a rough estimate of the area covered by each specimen. Measure the amount of water transpired by filling up each bottle to the original level, from a common medicine glass, or if this cannot be obtained, use a table spoon, counting two spoonfuls to the ounce. Make the best estimate you can of the number of leaves on each tree, and calculate the number of kilograms (or pounds) of water it would give off at that rate in a day. In one experiment a peach twig containing thirty-one leaves gave off three-quarters of an ounce of water in twenty-four hours; how many pounds would that be for the tree, estimating it to bear eighteen thousand leaves? As the tissues of a growing plant are much more active than those of a severed branch, calculations of this kind are not likely to exceed the truth, even when we take into consideration the fact that the twig in the experiment has unlimited water, which the roots of a growing plant have not always.

These experiments may be varied at the option of the teacher as time and opportunity may permit, so as to test the absorbing and transpiring properties of any number of plants or of the same plant at different stages of growth. They will succeed best in dry, warm weather, as the work of transpiration is then most active.

20. Practical Effects of Transpiration. — Where does all this moisture come from? If the water in the last experiment is colored with a little eosin or with red ink, its course can be traced through the stem into the leaves. In growing plants the earth takes the place of our tumbler of water, and from it the moisture is drawn up by the roots and conveyed through the stem to the leaves. Thus we see that trees are constantly acting as great pumps, drawing up water from the lower strata of the soil and distributing it to the thirsty air in summer. As the water given off by transpiration is in the form of vapor, it must draw from the plant the amount of heat necessary for its vaporization, and hence it has the effect of making the leaves and the air in contact with them cooler than the surrounding medium.

21. The Cause of Transpiration. — The reason why plants exhale such large quantities of water is because they get part of their food from mineral and other substances dissolved in the water of the soil, but this food is in such a diluted state that enormous quantities of the liquid containing it must be taken up in order to give the plant the nourishment it requires. This liquid travels through the stem as sap, and after all the food substance has been extracted, the waste water is exhaled by the leaves. Sometimes the roots absorb moisture faster than the leaves can transpire it; the water then exudes through the stomata and settles in drops on the blade, causing the leaves to sweat, just as our bodies do under similar conditions. Sometimes, on the other hand, the leaves transpire faster than the roots can absorb, and then the plant wilts.

PRACTICAL QUESTIONS

1. Do you see any connection between the facts just stated and the stories of "weeping trees" and "rain trees" that we sometimes read about in the papers? (Section 21.)
2. Can you explain the fact sometimes noticed by farmers, that in wooded districts, springs which have failed or run low during a dry spell sometimes begin to flow again in autumn when the trees drop their leaves, even though there has been no rain? (19, 20.)

3. Other things being equal, which would have the cooler, pleasanter atmosphere in summer, a well-wooded region or a treeless one? (20.)
4. Could you keep a bouquet fresh by giving it plenty of fresh air? (14.)
5. Why does a withered leaf become soft and flabby, and a dried one hard and brittle? (9, 14.)
6. Why do large-leaved plants, as a general thing, wither more quickly than those with small leaves? (14-19.)
7. Is the amount of water absorbed always a correct indication of the amount transpired? Explain. (20, 21.)
8. Why must the leaves of house plants be washed occasionally to keep them healthy? (15-18.)
9. Why is it so hard to get trees to live in a large manufacturing town? (15, 18.)

RESPIRATION AND FOOD PRODUCTION

MATERIAL. — A green aquatic plant of some kind in a glass of water; two wide-mouthed glass jars; a bent glass or rubber tube, and a shallow dish of water; boiled bean or tropæolum, or other green leaves; a half pint of alcohol; some tincture of iodine; a strip or two of tin foil.

22. Leaves give off Oxygen. — Place in a glass of water a green aquatic plant of any kind; the common brook silk (*Spirogyra*) found in almost every pool will answer. Set it in the sunlight and place beside it another similar vessel containing nothing but water, and also a third vessel containing a piece of the same plant immersed in water from which the air has been expelled by boiling. After a time bubbles will be seen rising from the first vessel. Air bubbles will usually form on the bottom and sides also, but these are caused by the expansion of gases contained in the liquid, as will be evident on comparing them with similar phenomena in the jar containing only water, and must not be confounded with the gas given off by the plant. Remove the vessel from the light, and the bubbles will soon cease to appear, but will begin to form again if restored to the sunshine, thus showing that their production can take place only in the light. Do any bubbles at all appear in the glass with the boiled water?

It has been proved by chemical analysis that these bubbles are oxygen, which the plant has been separating

from the gases mixed with the water, and giving off. It is even more active in separating oxygen from the air, but the process is not visible to the eye, because we cannot see a gas except in the form of bubbles. Water is used not as an aid to the plant in the performance of its function, but in order to enable us to see the result.

23. Leaves as Purifiers of the Atmosphere.— Fill two tumblers with water, to expel the air, and invert in a shallow dish of water, having first introduced a freshly cut sprig of some healthy green plant into one of them.



8. — Experiment for showing how leaves purify the atmosphere.

Then by means of a bent tube blow into the mouth of each tumbler till all the water is expelled by the impure air from the lungs. Set the dish in the sunshine and leave it, taking care that the end of the cutting is in the water of the dish.

After forty-eight hours remove the tumblers by running under the mouth of each, before lifting from the dish, a piece of glass well coated with vaseline (lard will answer) and pressing it down tight so that no air can enter. Place the tumblers in an upright position, keeping them securely covered. Fasten a lighted taper or match to the end of a wire, plunge it quickly first into one tumbler, then into the other, and note the result. It is an established fact that a light will not burn in an impure atmosphere; this is why well cleaners send down a lighted candle before going into a well themselves. What are we to infer from the effects observed as to the action of the plant upon the atmosphere?

This experiment will not succeed unless performed very carefully, and the air must be absolutely excluded from the tumblers until the instant the taper is plunged in.

24. Leaves as Food Makers.— It thus appears that plants are constantly reversing the effects of animal respiration by giving off oxygen and absorbing carbon dioxide from the air. Besides acting as digestive and assimilating

organs, leaves are the laboratories in which plant food is manufactured out of the crude materials brought up from the soil by the sap, and those absorbed through the stomata from the gases of the atmosphere. Carbon dioxide taken from the atmosphere is somehow used up in this operation, and the oxygen, which is not needed by the plant, is given back to be consumed by animals. This is the most important work the leaf has to do, and because it can take place only in the light, has been named by botanists *Photosynthesis*, a word which means "building up by means of light," just as *photography* means "drawing up or engraving by means of light."

25. Why Leaves are Green.—Has the color of the leaf anything to do with this function? It will help to a correct answer if we remember that herbs grown in the dark, and parasites like the dodder and beech drops (*Epiphegus*), which steal their food ready made from the tissues of other plants, and so have no need to manufacture it for themselves, always lose their green color. Place a seedling of oats or other rapidly growing shoot in the dark for a few days and note its loss of color. Leave it in the dark indefinitely, and it will lose all color and die. Hence we may conclude that there is some intimate connection between the action of light and the green coloring matter of leaves. This green matter is called *Chlorophyll*, a word meaning "leaf green," and physiologists tell us that through its agency the crude substances brought up from the soil in the sap and the carbon dioxide of the air are converted into nourishment.

26. Starch as Plant Food.—It is the office of chlorophyll to manufacture a particular class of plant foods known as *carbohydrates*. The commonest and most important of these is starch, the presence of which can generally be detected without much difficulty. Boil a few leaves of bean or sunflower, *tropæolum*, etc., for about fifteen minutes, and soak them in alcohol until all the chlorophyll is dissolved out. Rinse them in water, and soak the leaves

thus treated, in a weak solution of iodine for half an hour ; then wash them and hold them up to the light. Iodine turns starch blue ; hence if there are any blue spots on the leaves, what are you to conclude ? Other food substances can be detected by proper tests, but none of them so readily as starch.



9. — Leaf arranged with a piece of tin foil to exclude light from a portion of the surface.

27. Necessity of Light and Air.

— Exclude the light from parts of healthy leaves on a growing plant of *tropæolum*, bean, etc., by placing bands or patches of tin foil over them. Leave in a bright window, or preferably out of doors, for twenty-four to forty-eight hours, and then test for starch as in the last experiment ; do you find any in the shaded spots ?

Cover the lower side of several leaves with vaseline or other oily substance so as to exclude the air, and after a day or two test as before.

From these experiments we learn that leaves can not do their work without light and air. The particular element of the atmosphere used by them in the process of food making is carbon dioxide, a poisonous gas that is being constantly produced by the decay of vegetable and animal matter, by the respiration of animals, and by combustion of all sorts. It constitutes about one fourth of one per cent of our atmosphere, and when the proportion rises much above this, the air becomes unfit to breathe, so that the work of plants in eliminating it is a very important one.

28. Respiration. — The leaf is also an organ of respiration ; that is, it is always taking in oxygen and giving off carbon dioxide, just as animals do, but in such small quantities that the process is entirely obscured during the day by the much more active function of photosynthesis, or food making, which goes on at the same time. For this

reason it was formerly believed that respiration, or the absorption of oxygen by plants, took place only at night, and some people were led to imagine from this that it is unwholesome to have potted plants in a bedroom; but the quantity of oxygen absorbed by green plants is so small as to be scarcely appreciable.

While the leaf is the principal organ of respiration, this function is carried on in other parts of the plant also, else it could not survive during the leafless months of winter. It goes on at all times, in all living parts, and the other leaf functions also are carried on, to some extent, in all green tissues.

29. Relation of Respiration to Other Functions. — The functions of photosynthesis and respiration are mutually complementary and interdependent, the one manufacturing food, and the other using it up, or rather marking the activity of those life processes by which it is used up. In this respect it is strictly analogous to the respiration of animals. The more we exert ourselves and the more vital force we expend, the harder we breathe, and hence respiration is more active in children than in older persons, and in working people than in those at rest. It is just the same with plants; respiration is always most energetic in germinating seedlings and young leaves, in buds and flowers, where active work is going on; hence such organs consume proportionately large quantities of oxygen and liberate correspondingly large quantities of carbon dioxide.

Fill a glass jar of two liters' capacity (about two quarts) with germinating seeds, or with flower buds or unfolding leaf buds arranged in layers alternating with damp cotton batting or blotting paper; close it tightly and leave it for twelve to twenty-four hours. If the jar is then opened and a lighted taper



10. — Arrangement of apparatus to show that carbon dioxide is given off by germinating seeds.

plunged in, it will be extinguished as quickly as in the empty tumbler in the experiment described in Section 23, thus showing that the process of respiration is more active in this case than the opposite function of taking in carbon dioxide and liberating oxygen. Insert a thermometer bulb and note the difference in temperature. In some of the arums, — calla lily, Jack-in-the-pulpit, elephant's ear (*Colocasias*), etc., — where a large number of small flowers are brought together within the protecting spathe, the rise of temperature is sometimes so marked that it may be perceived by placing a flower against the cheek.¹

30. Metabolism. — The total of all the life processes of plants, including growth, waste, repair, etc., is summed up by botanists under the general term *Metabolism*. It is a constructive or building-up process when it results in the making of new tissues out of the food absorbed from the earth and air, and consequent increase of the plant in size or numbers. But, as in the case of animals, so with plants, not all the food provided is converted into new tissue, a part being decomposed and excreted as waste. In this sense, metabolism is said to be *destructive*, and, like other destructive processes (combustion, for instance), is always accompanied by the liberation of energy, — heat, as we have seen, being an invariable accompaniment. The waste in healthy plants is always, of course, less than the gain, and a large portion of the food material is in all cases laid by as a reserve store. For this reason, photosynthesis, which is a constructive process, is usually more energetic than respiration, which is the measure of the destructive change of materials that attends all life processes.

It is evident also, from what has been said, that growth and repair of tissues can take place only so long as the plant has abundant oxygen for respiration, since the food material manufactured by it must be decomposed into the

¹ See Sachs, "Physiology of Plants."

various substances required by the different tissues before it can be appropriated by them.

PRACTICAL QUESTIONS

1. Why do gardeners bank up celery to bleach it ? (25.)
2. Why are the buds that sprout on potatoes in the cellar white ? (25.)
3. Why does young cotton look so pale and sickly in long-continued wet or cloudy weather ? (25.)
4. Why do parasitic plants generally have either no leaves or very small, scalelike ones ? (25.)
5. The mistletoe is an exception to this ; can you tell why ? (184.)
6. Could an ordinary self-supporting plant live without green leaves ? (26, 27.)
7. Are abundance and color of foliage any indication of the health of a plant ? (24, 26.)
8. Is the practice of lopping and pruning very closely, as in the process called "pollarding," beneficial to a tree under ordinary conditions ? (18, 21, 24, 26.)
9. Why is it wise to trim a tree close when we transplant it ? (20, 21.)
10. Why should transplanting be done in winter or very early spring, when the leaves are off ? (19, 20.)
11. Name some plants of your neighborhood that grow well in the shade.
12. Compare in this respect Bermuda grass and Kentucky blue grass ; cotton and maize ; horse nettle (*Solanum Carolinense*) and dandelion ; beech, oak, red maple, dogwood, pine, cedar, holly, magnolia, etc.
13. Why are evergreens more abundant in cold than in warm climates ? (19, exp.)
14. Is it wholesome to keep blooming plants in a bedroom ? Leafy ones ?
15. Why, in each case ? (23, 28.)

THE TYPICAL LEAF AND ITS PARTS

MATERIAL. — Leaves of as many different kinds as can conveniently be obtained, showing their various modes of attachment, shapes, texture, etc. For stipules, leaves on very young twigs should be sought for, as these bodies often fall away soon after the leaves expand. The rose, Japan quince (*Pyrus Japonica*), willow, strawberry, pansy, pea, and young leaves of apple, peach, elm, oak, beech, tulip tree (*Liriodendron*), India rubber tree (*Ficus elastica*), magnolia, etc., furnish good examples of stipules.

31. Parts of the Leaf. — Examine a young, healthy leaf of apple, quince, elm, etc., as it stands upon the stem, and



11. — A typical leaf and its parts: *b*, blade; *p*, petiole; *s*, *s*, stipules.

notice that it consists of three parts: a broad expansion called the *blade*; a leaf stalk or *petiole* that attaches it to the stem; and two little leaflike or bristlelike bodies at the base, known as *stipules*. Make a sketch of any leaf provided with all these parts and label them respectively blade, petiole, and stipules. These three

parts make up a perfect or typical leaf, but as a matter of fact, one or more of them is usually wanting.

32. Stipules. — The office of stipules, when present, is generally to subserve



13. — Sheathing stipules of "prince's feather" (*Polygonum orientale*) (GRAY).

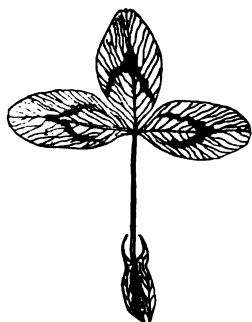
in some way the purposes of protection. In many cases, as the fig, elm, beech, oak, magnolia, etc., they appear only as protective scales that cover the bud during winter, and fall away as soon as the leaf expands. When *persistent*, that is, enduring, they sometimes take the form of spines and thorns, as in the black locust and spiny clotbur (*Xanthium spinosum*). The sheathing stipules of the smartweeds and bindweeds (*Polygonum*) serve to strengthen the stem at the joints (Fig. 13), and the adnate stipules (Fig. 14) of the rose, clover, strawberry, etc., may serve either as water holders or as shields against climbing insects. In the smilax and some other vines they appear as tendrils for climbing, while in other cases, as the garden pea and pansy, they become large and leaflike, or may even usurp the place of



12. — Spiny stipules of Clotbur.

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the leaves altogether, as in the *Lathyrus aphaca* (Fig. 17),



14.—Adnate stipules of clover.

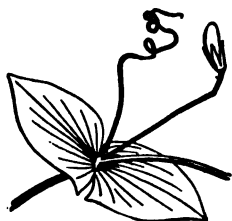


15.—Leaves of smilax, showing stipular tendrils.



16.—Leafy stipules of Japan quince.

a near relative of the sweet pea, where they function as foliage. But under whatever form they occur, their true nature may be recognized by their position on each side of the base of the petiole, and not in the *axil*, or angle formed by the leaf with the stem.



17.—Leaf of *Lathyrus aphaca*, reduced to a pair of stipules and a tendrill (after GRAY).

33. Petioles.—The normal use of the petiole is to secure a better light exposure for the leaves, but like other parts of the leaf, it is subject to modifications. In some vines, such as the jasmine nightshade and tropæolum of the gardens, it is twisted into a tendrill for climbing. Occasionally the leaf blade disappears altogether and the leaf stalk takes its place, as in some of the Australian acacias frequently seen in greenhouses. Simulated leaves of this kind can generally be distinguished by their edgewise position, the blades of true leaves being usually horizontal. Other instances occur, such as the onion, jonquil, hyacinth, etc., where the distinction, if any exists, is difficult to make out.

In the sycamore, the base of the petiole is hollowed out into a socket to protect the bud of the season (Fig. 20).

34. Leaf Attachment. — When the petiole is wanting altogether, as is often the case, leaves are said to be *sessile*, that is, *seated* on the stem, and their bases are described by various terms suggestive of the mode of attachment. You can frame your own definition of these terms by an inspection of the accompanying figures, or better still, of some of the sample plants named in connection with each.

Clasping (Fig. 21): Wild lettuce (*Lactuca*), chicory, sow thistle (*Sonchus*), poppy, stem leaves of turnip, mustard, etc.

Decurrent (Fig. 22): Thistle, sneezeweed (*Helenium autumnale*), comfrey (*Symphytum*).

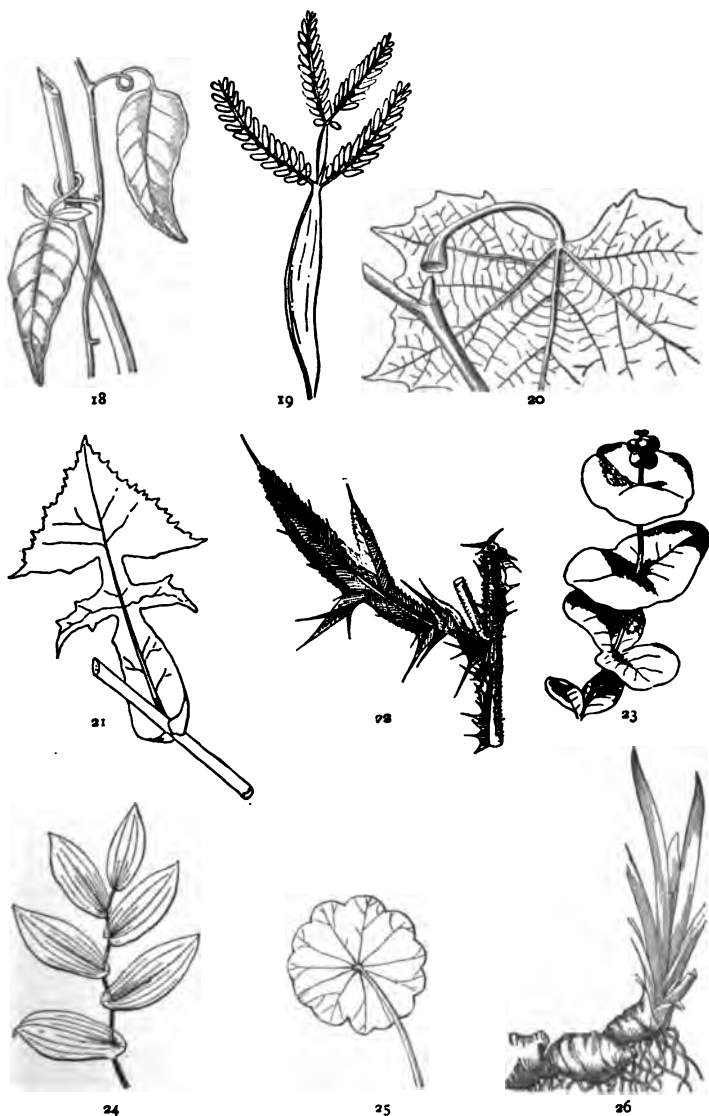
Connate (Fig. 23): The upper leaves of boneset (*Eupatorium perfoliatum*) and trumpet honeysuckle (*Lonicera sempervirens*).

Perfoliate (Fig. 24): Bellwort (*Uvularia perfoliata*).

Peltate, or shield-shaped (Fig. 25): Castor oil plant, tropæolum, May apple (*Podophyllum*), water pennywort (*Hydrocotyle*).

Equitant (Fig. 26): Iris, sweet flag (*Acorus Calamus*), blackberry lily (*Belamcanda Chinensis*).

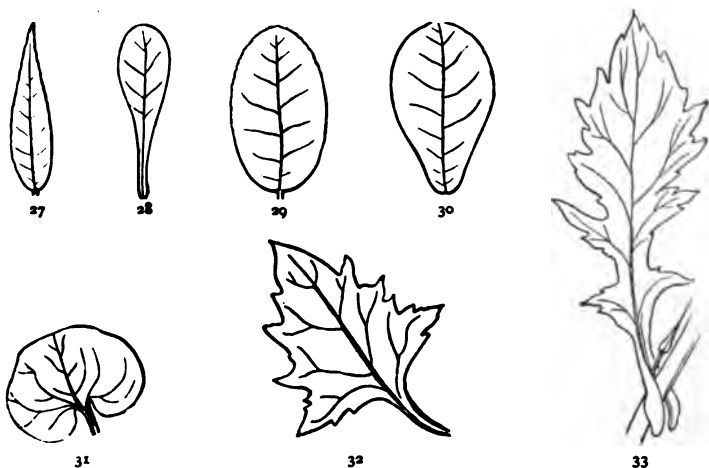
35. The Use of Botanical Language. — These terms and those which follow are not to be learned by heart, but are given here merely for convenience of reference. Botanists have invented a number of useful terms for describing things briefly and accurately, and while they are not to be regarded as of any importance in themselves, it is impossible to get along without some knowledge of them; for besides furnishing a sort of universal vocabulary, intelligible to botanists everywhere, they enable us to say in two or three words what it would otherwise require as many lines or perhaps paragraphs to express. In other words, they are a sort of labor-saving device which every botanist must learn how to use, as no good workman can afford to be ignorant of the tools of his profession.



18-26.—Petioles, and leaf attachment: 18, petioles of jasmine nightshade (*Solanum jasminoides*) acting as tendrils; 19, acacia, showing petiole transformed to leaf blade; 20, petiole of sycamore hollowed out to protect the bud of the season; 21, clasping leaf of lactuca; 22, decurrent leaf of thistle; 23, connate leaves of honeysuckle; 24, perfoliate leaves of uvularia; 25, peltate leaf of tropæolum; 26, equisant leaves of iris. (18, 20, 23, 24, 25, and 26, after GRAY,;

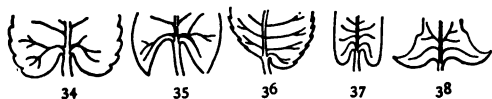
36. Shape and Texture of Leaves. — Examine a number of leaves of different kinds and see how they differ from each other in regard to —

General Outline: whether round, oval, heart-shaped, lanceolate, etc. (Figs. 27–33).



27–33. — Shapes of leaves: 27, lanceolate; 28, spatulate; 29, oval; 30, obovate; 31, reniform, or kidney-shaped; 32, deltoid; 33, lyrate. (27–31, *after* GRAY.)

Base: tapering, obtuse, truncate, cordate, etc. (Figs. 34–38).



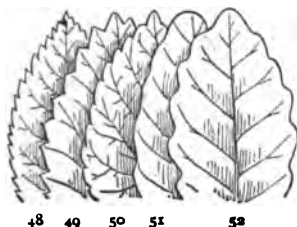
34–38. — Bases of leaves: 34, cordate; 35, sagittate; 36, oblique; 37, auricled; 38, hastate.



39–47. — Apices of leaves: 39, acuminate; 40, acute; 41, obtuse; 42, truncate; 43, 44, emarginate; 45, obcordate; 46, cuspidate; 47, mucronate (GRAY).

Apex: acute, acuminate, emarginate, etc. (Figs. 39–47).

Margins: some being unbroken or *entire*, others variously toothed and cut (Figs. 48-53).



48-53.—Margins of leaves: 48, serrate; 49, dentate; 50, crenate; 51, undulate; 52, sinuate; 53, runcinate leaf of dandelion. (48-52, after GRAY.)

Symmetry: that is, whether the two halves are alike, so that if folded over on each other they would coincide.

Texture: whether thick or thin, fleshy and soft, hard and brittle, or tough and leathery (*coriaceous*).

Surface: smooth and shining (*glabrous*); wrinkled (*rugose*); hairy (*pubescent*); covered with a bloom (*glaucous*); moist and sticky (*viscid*, or *glandular*).

PRACTICAL QUESTIONS

1. Tell the nature and use of the stipules in such of the following plants as you can find: tulip tree; fig; beech; apple; willow; pansy; garden pea; Japan quince (*Pyrus Japonica*); sycamore; rose; paper mulberry (*Broussonetia*).

2. State what differences and resemblances you observe between the leaves of the elm, beech, birch, alder, hackberry, hornbeam.

Between the hickory, ash, common elder, walnut, ash-leaved maple (*Negundo*), ailanthus, sumac.

Between the persimmon, black gum, buckthorn, papaw (*Asimina*), sourwood (*Oxydendron arboreum*).

Between chinquapin, chestnut, and chestnut oak.

Any other sets of leaves may be substituted for those named, the object being merely to form the habit of distinguishing readily the differences and resemblances between leaves that bear some general likeness to one another.

Notice that the general resemblances are not confined to plants of closely related species: what other causes may influence them?

VEINING

MATERIAL. — A specimen of each of the different kinds of veining. For parallel veining any kind of arum, lily, or grass will do ; for net veining, ivy, maple, elm, or peach, etc. Classes in cities can use leaves from potted plants of wandering Jew (*Zebrina pendula*), calla lily, and other easily cultivated specimens, or blades of grass, plantain, and various parallel and net veined weeds can be picked up here and there, even in the largest cities. Have a number of leaves placed with their cut ends in red ink from three to six hours before the lesson begins.

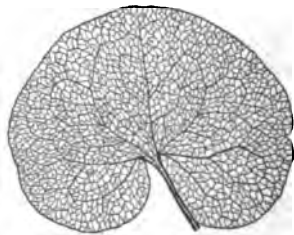


54.— Parallel-veined leaf of lily of the valley (after GRAY).

37. Parallel and Net Veining. — Compare a leaf of the wandering Jew, garden lily, or any kind of grass, with one of cotton, maple, ivy, etc. Hold each up to the light, and note carefully the veins or little threads of woody substance that run through it. Make a drawing of each so as to show plainly the direction and manner of veining. Write under the first, *Parallel veined*, and under the second, *Net veined*. This distinction of leaves into parallel and net veined corresponds with another important difference in plants, existing in the seed, and is used by botanists

in distinguishing the two great classes into which seed-bearing plants are divided.

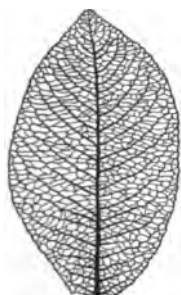
38. Pinnate and Palmate Veining. — Next, compare a leaf of the canna, or of any of our common garden arums, with one of the elm, peach, cherry, etc., or with a leaflet of the rose or clover.



55.— Palmately net-veined leaf of *Asarum Europæum*.

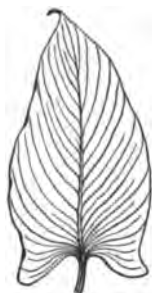
Hold both up to the light and observe carefully the veins and reticulations. What resemblance do you notice between the two? What difference? Which is parallel veined and which is net veined? Make a drawing of each, and compare with the first two. Notice that

in the last, the petiole seems to be continued in a large central vein, called the *Midrib*, from which the secondary veins branch off



57.—Pinnately net-veined leaf of a willow.

on either side just as the pinnæ of a feather do from the quill; whence such leaves are said to be *pinnately*, or *feather* veined. In the cotton, maple, ivy, etc., on the other hand, the petiole breaks up



56.—Pinnately parallel-veined leaf of calla lily (after GRAY).

at the base of the leaf (Fig. 55) into a number of primary veins or ribs, which radiate in all directions like the fingers from the palm of the hand; hence, such a leaf is said to be *palmately* veined.

39. Ribbed Leaves.—Net-veined leaves are sometimes ribbed in a way that might lead an inexperienced observer to confound them with parallel-veined ones. Compare, for instance, a leaf of the wild smilax (often improperly called bamboo), or of the common plantain, with one of the kind represented in Figure 54. A little inspection will show that in both the ribs all proceed from the same point at the top of the petiole, as in other leaves of the palmate kind, of which they are varieties, but the reticulations between the ribs in the smilax and plantain show that they belong to the net-veined division.



58.—Ribbed leaf of plantain.

40. Parallel-veined and Straight-veined Leaves.—In some pinnate leaves, like the elm, beech, birch, dogwood, etc., the secondary veins are so straight and regular that beginners are apt to confound them with the parallel kind represented in Figure 56, but this mistake need never occur

if the reticulations of the smaller veinlets are noted. Then, too, it must be observed that in a pinnately parallel-



59. — Straight-veined leaf of dogwood.

veined leaf the secondary veins do not separate from the midrib in such sharp, clear-cut angles as we see in the beech and elm, but seem to flow into it and mingle gradually with it, so that the midrib has the appearance of being made up of the overlapping fibers of the smaller veins, as in Figure 56.

41. Use of the Veins. — Hold up a stiff, firm leaf of any kind, like the magnolia, holly, or India rubber, to the light, having first scraped away a little of the under surface, and examine it with a lens. Compare it with one of softer texture, like the peach, maple, grape, cotton, clover, etc. In which are the veins closest and strongest? Which is most easily torn and wilted? Tear a blade of grass longitudinally and then crosswise; in which direction does it give way most readily? Tear apart gently a leaf of cotton, maple, or ivy, and one of elm or other pinnately veined plant; in which direction does each give way with least resistance? What would you judge from these facts as to the office of the veins?

42. Effect upon Shape. — By comparing a number of leaves of each kind, it will be seen that the feather-veined ones tend to assume elongated outlines (Figs. 16, 33, 53), while the palmate veining produces more broad and rounded forms (Figs. 25, 55, 61). Notice also that the straight, unbroken venation of parallel-veined leaves is generally accompanied by smooth, unbroken margins, while the irregular, open meshes of net-veined leaves are favorable to breaks and indentations of all kinds.

43. Veins as Water Pipes. — Examine a leaf that has stood in red ink for two or three hours. Do you see evidence that it has absorbed any of the liquid? Cut across the blade and examine with a lens. What course has the

absorbed liquid followed? What use does this indicate for the veins, besides the one already noted?

We thus see that the veining serves two important purposes in the economy of the leaf; first, as a skeleton, or framework, to support the expanded blade; and second, as a system of supply pipes, or waterworks for conveying the sap out of which its food is manufactured.

The microscope shows us that the veins are made up of clusters or bundles of woody fibers, mixed with long, tubular cells that serve as vessels for conducting the sap; hence they are called *fibrovascular* bundles; which means bundles composed of fibers and conducting vessels. In this way the veins get both their hardness and their water-conducting power. The tough, stringy threads that protrude from the petiole of a plaintain leaf when broken are made of fibrovascular bundles that supply the leaf blade.

PRACTICAL QUESTIONS

1. In selecting leaves for decorations that are to remain several hours without water, which should you prefer, and why: Smilax or Madeira vine (*Boussingaulia*)? Ivy or Virginia creeper? Magnolia or maple? Maidenhair or shield fern (*Aspidium*)? (41, 43.)
2. Should you select very young leaves, or more mature ones, and why?
3. Can you name any parallel-veined leaves that have their margins lobed, or indented in any way?
4. Which are most common, parallel-veined or net-veined leaves?
5. Why do the leaves of corn and other grains not shrivel lengthwise in withering, but roll inward from side to side? (41.)
6. Can you name any palmately-veined leaves in which the secondary veins are pinnate? Any pinnately-veined ones in which the secondary veins are palmate?
7. Account for the difference.

BRANCHED LEAVES

MATERIAL. — Lobed and compound leaves of various kinds. Many good examples can be found among the weeds growing on vacant lots in cities.

44. Lobing. — Compare the outline of a leaf of maple or sweet gum with one of oak or chrysanthemum. Do

you perceive any correspondence between the manner of lobing or indentation of their margins, and the direction of the veins? To what class would you refer each one?

The lobes themselves may be variously cut, as in the



60. — Pinnately lobed leaf of an oak.



61. — Palmately lobed leaf of grape.

fennel and rose geranium, thus giving rise to twice-cleft, thrice-cleft, four-cleft, or even still more intricately divided leaves. Where the divisions are very deep it may sometimes be a little puzzling to decide whether they are not



62. — Pinnately divided leaf of a buttercup.

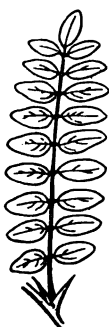


63. — Palmately parted leaf of tall buttercups.

separate leaflets, but if there is the merest thread of green connecting the segments, as in Figures 62 and 63, it is considered a simple lobed leaf.

45. Compound Leaves. — Compare with the specimens just examined a leaf of horse-chestnut, clover, or Virginia

creeper, etc., and one of rose, black locust, vetch, or other pinnate leaf. Notice that each of these last is made up of entirely separate divisions or leaflets, thus



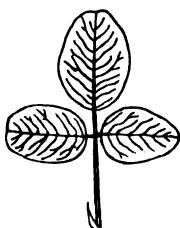
64. — Pinnately compound leaf of black locust.



65. — Palmately compound leaf of horse-chestnut.

forming a *compound leaf*. Notice also that the two kinds of compound leaves correspond to the two kinds of veining and lobing, so that we have palmately and pinnately compound ones. In pinnate leaves the continuation of the common petiole along which the leaflets are ranged is called the *Rhachis*.

46. Trifoliate Leaves. — In a trifoliate leaf, or one of three parts, it is often difficult for a beginner to decide whether the divisions are palmate or pinnate. To settle this question, compare a leaf of lucerne, beggar's ticks, or



66. — Pinnately trifoliate leaf of a desmodium.



67. — Palmately trifoliate leaf of wood sorrel.

bush clover (*Lespedeza*), with one of wood sorrel (*Oxalis*), or any common clover, and observe the mode of attachment of the terminal leaflet. When the common petiole is prolonged ever so little beyond the insertion of the

two lateral leaflets, so as to form a rachis, as in Figure 66, the leaf is pinnately trifoliolate; but if all three appear to spring directly from the top of the petiole, as in Figure 67, it is palmate. A good example of a pinnately trifoliolate leaf, and one which it is important to learn and remember, is the poison ivy.



68.—Poison ivy.

47. Unity of Plan in Nature.—Notice how the same plan of structure runs unchanged through all these variations. If an oak or a tansy leaf were cut through to the midrib, we should have a pinnately compound leaf, while a sweet gum or a maple cut in the same way would give rise to a palmately compound one.

48. The Branching of Leaves.—Lobed and compound leaves represent mere degrees of branching. Notice, however, that their mode of branching differs from that of stems in having the branches all in the same plane, like figures cut out of a single sheet of paper. This is what we should expect in the case of expanded bodies whose primary object is exposure to the light.

49. What makes a Compound Leaf.—Some botanists do not regard a branched leaf as compound unless the leaflets are jointed to the common petiole so that they break and fall away separately in autumn, like those of the ash, horse-chestnut, china tree, etc. According to this defi-



69.—Leaf of common orange.



70.—Leaf of trifoliolate orange.

niton, the single leaf of the orange and lemon is compound, for it is jointed to the petiole like those of the ash and hickory. This view is supported by the fact that some species of orange have trifoliolate leaves.

PRACTICAL QUESTIONS

1. State whether such of the following leaves as you can find are lobed or compound: cinquefoil, wood anemone, tree fern (*Polypodium incanum*), buttercups, Dutchman's breeches (*Dicentra*), mayweed, chamomile, yarrow, tickseed (*Coreopsis*), shield fern, agrimony, tomato, tansy, cosmos, cypress vine, wild carrot, larkspur, strawberry, monkshood, celandine.

2. Which of the following are pinnately and which palmately trifoliolate? Lucerne, red clover, Japan clover (*Lespedeza striata*), beggar's ticks (*Desmodium*), sweet clover (*Melilotus*), kidney bean, strawberry.

3. Name some of the favorite shade trees of your neighborhood; do they, as a general thing, have their leaves entire, or branched and compound?

4. Which of the following are the better shade trees, and why: pine, white oak, mimosa (*Albizia*), sycamore, locust, horse-chestnut, fir, maple, linden, China tree, cedar, ash?

5. Which would shade your porch better, and why: cypress vine, grape, gourd, morning-glory, wistaria, clematis, smilax, kidney bean, Madeira vine, rose, yellow jasmine, passion flower?

PHYLLOTAXY, OR LEAF ARRANGEMENT

MATERIAL. — Twigs of any kinds of plants with opposite and alternate leaves. For the different orders of alternate arrangement, elm, ivy, basswood, wandering Jew, or any kind of grass will show the first; alder, birch, or any kind of sedge, the second; peach, oak, cherry, or almost any of our common trees and shrubs, the third (in cities, a potato plant grown in a pot may be used). In selecting specimens, choose straight, young twigs in order to avoid confusion from twisting of the stem that often occurs in older specimens on account of light exposure, or from other causes.

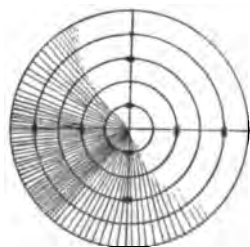
50. Alternate and Opposite Leaves. — Compare the arrangement of leaves on a twig of elm or basswood, or on a culm of grass, etc., with that of the foliage of the maple, lilac, or honeysuckle. Make a vertical diagram of each, as

shown in Figures 73 and 74, illustrating the two modes of arrangement. Label the point at which the leaf is in-



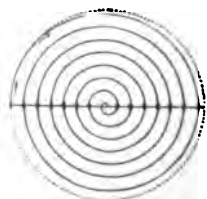
71-74.—Arrangement of leaves: 71, opposite-leaved twig of spindle tree; 72, alternate-leaved twig of apple; 73, vertical diagram of opposite-leaved twig; 74, vertical diagram of two-ranked twig of elm. (71, 72, after GRAY.)

sented, the *node*; the space between any leaf and the one next above or below it, the *internode*; and angle between the leaf and the stem, where you see the bud, the *axil*. How many leaves are there at a node in the elm and basswood? How many in the maple and honeysuckle? Are the two consecutive pairs of leaves in the latter placed directly over each other, or at right angles? How far round from the first leaf does the second stand in the elm, grass,



75.—Horizontal diagram of opposite leaves.

etc.? How does its position differ from that of the same leaf in the opposite mode of insertion? How many leaves must be passed in order to complete a turn round the stem, and what leaf in numerical order stands directly above the first? Draw a horizontal diagram of both twigs repre-



76.—Horizontal diagram of two-ranked leaves.

representing the two kinds of arrangement as viewed from above. Notice that if we join the leaves in the opposite arrangement by dotted lines we shall get a series of circles (Fig. 75), while the alternate arrangement will give a spiral (Fig. 76).

These two kinds of insertion, the alternate and opposite, represent the fundamental forms of leaf disposition. There may be varieties of each, but no matter what minor differences exist, all may be referred to one of these two modes.

51. Whorled and Fascicled Leaves.—Where more than two leaves occur at a node they constitute a *whorl*, or *verticel*, as in the trillium and common cleavers (*Galium*). There is no limit to the number of leaves that may be in a whorl except the space around the stem to accommodate them.



77



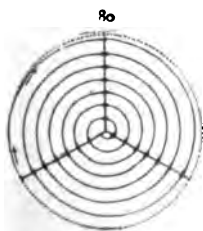
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77-78.—Whorls and fascicles: 77, whorled leaves of Indian cucumber; 78, fascicled leaves of pine.

A *fascicle*, or cluster, of which the pine and larch furnish examples, is composed of alternate leaves with very short internodes, which bring the leaves so close together as to give them the appearance of a whorl.



79



80

79-80.—Three-ranked arrangement: 79, vertical diagram; 80, horizontal diagram.

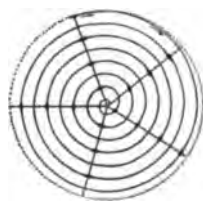
52. Varieties of Alternate Arrangement.—The kind of alternate arrangement just described is called the two-ranked, because it distributes the leaves in two rows on opposite sides of the stem;

in other words, each is just halfway round from the one next above or below it. Other common forms of the alter-

nate or spiral arrangement are the three-ranked (Figs. 79 and 80), in which three leaves are passed in completing a turn round the stem, the fourth in vertical order standing over the first; and the five-ranked (Figs. 81 and 82), in which five leaves are passed in making *two* turns, and the sixth in numerical order stands above the first. This is the commonest of all the modes of insertion, and the



81



82

81-82.—Five-ranked arrangement: 81, vertical diagram; 82, horizontal diagram.

one that prevails among our forest trees and shrubs. The two-ranked is characteristic of the grass family, and the three-ranked of the sedges, though both occur among other plants as well. Specimens of all the kinds mentioned should be examined and compared with the dia-

grams. There are other and more complicated arrangements, but they are not common enough to demand attention here.

53. Relation between Phyllotaxy and the Shape of Leaves.

—Compare the vertical distance between leaves on the same and on different twigs; are the internodes all of the same length? Where the internodes are short, the leaves will be crowded together in closer vertical rows.

A compact arrangement of this sort tends to shut off light from the lower leaves; hence, in plants where it prevails, the leaves are apt to be long and narrow in proportion to the frequency of the vertical rows. The yucca, oleander, Canada fleabane, and bitterweed (*Helenium tenuifolium*), all illustrate this law.



83.—Narrow leaves in crowded vertical rows.

On the other hand, where the internodes are long or the vertical rows few, the leaves tend to assume more broad and rounded shapes, as in the cotton, hollyhock, sunflower, etc. If the blades are much cut and lobed, so that the



84. — Long internodes and large leaves.



85. — Dissected leaves overlapping one another without injurious shading.

sun easily strikes through, they can bunch themselves in almost any way without injurious shading. The length of the internodes depends, to a large extent, upon the rapidity of growth, being usually much greater in vigorous young shoots and the terminal portion of the main stem than in the lateral branches.

PRACTICAL QUESTIONS

1. Strip the leaves from a twig of one order of arrangement and replace them with foliage from a twig of a different order; for instance, place basswood upon white oak, birch upon lilac, elm upon pear, honeysuckle on barberry, etc. Is the same amount of surface exposed as in the natural order?

2. What disadvantage would it be to a plant if the leaves were arranged so that they stood directly over one another? (24, 25, 27.)

3. Why are the internodes of vigorous young shoots, or scions, generally so long? (53.)

4. If the upward growth of a stem or branch is stopped by pruning, what effect is produced upon the parts below, and why?

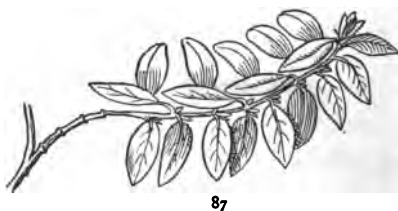
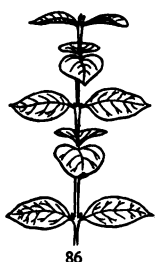
5. Why does corn grow so small and stunted when sown broadcast for forage?

6. What is the use of "chopping" (*i.e.* thinning out) cotton?

LEAF ADJUSTMENT

MATERIAL. — Upright and horizontal twigs from the same plant, any kind obtainable. A potted plant of oxalis, spotted medick, white clover or Japan clover (*Lespedeza striata*), or any other irritable kind.

54. Leaves adjust themselves to Light. — Take two sprigs, one upright, the other horizontal, from any convenient shrub or tree — those with opposite, or two-ranked leaves, like the elm and linden will generally show this peculiarity best — and notice the difference in the position of the leaves. Examine their points of attachment and see how this is brought about, whether by a twist of the petiole or of the base of the leaf blades, or by a half twist of the stem between two consecutive leaves, or by some other



86, 87. — Adjustment of leaves to different positions: 86, upright; 87, procumbent.

means. Observe both branches in their natural position; what part of the leaf is turned upward, the edge or the surface of the blade? Change the position of the two sprigs, placing the vertically growing one horizontal, and the horizontal one vertical. What part of the leaves is turned upward in each? One need only glance at the sky on any bright day and see how the light falls to understand the meaning of this adjustment. Would the same amount of light and air be secured by any other?

Rose bushes and a few other plants sometimes take on a second growth in late summer and autumn. If you can find such a plant, bend a young vertical branch into a horizontal position, and a horizontal one into an upright position and fasten them there. Examine at intervals and note the adjustment of the new leaves as they develop.

55. Mosaics and Rosettes. — A very little observation will show that trees with horizontal or drooping branches, like the elm and beech, and vines growing along walls or trailing on the ground, generally display their foliage in flat, spreading layers, each leaf fitting in between the interstices of the others like the stones in a mosaic, whence this has been called the *mosaic* arrangement. In plants of more upright or bunchy habit, on the other hand, the leaves grow at all angles, with a general tendency to cluster in rosettes at



88. — Leaf mosaic of elm.

the end of the branches, as in the magnolia, horse-chestnut, sweet gum, etc., thus giving rise to what is known as the *rosette* arrangement.



89



90

89, 90. — Horse-chestnut leaves: 89, leaf rosette seen from above; 90, the same seen sidewise, showing the formation of rosettes by the lengthening of the lower petioles.

56. Leaf Cones and Pyramids. — These forms usually result from a lengthening of the lower petioles to secure a better light exposure for the under leaves, or from an increase in the size of the leaves themselves, as we see in the rosettes that form about the roots of our common biennial and perennial herbs in winter. To the same

cause is due the pyramidal shape assumed by plants like the mullein and burdock, with large, undivided leaves which the light cannot strike through. The foliage on the upright stalk that rises from these rosettes in spring constantly diminishes from the ground upward, giving the plant the general outline of a sort of vegetable Eiffel tower. The upper leaves, too, will generally be found to assume a more or less vertical position so as not to cut off too much light from those below.



91. — Leaf pyramid of mullein.



92. — A plant that has been growing near an open window, showing the leaves all turned toward the light.

57. Heliotropism. — If there is any doubt about the object of all these careful adjustments it can be settled by placing any healthy young potted plant near a sunny window and at the end of a day or two, observing the position of the leaves. Then turn the pot round so that the leaves will face away from the light, and again, after a few days, observe any change that has taken place in their position. Try the experiment as often as you like and with any number of different plants, the result will be the same. This movement of plants in



93. — Rhubarb plant with leaves adjusted for centripetal drainage.



94. — A caladium showing centrifugal drainage.

response to the influence of light is called *heliotropism*, a word that means "turning to or with the sun."

58. Leaf Drainage. — Another important adjustment that leaves undergo is in regard to water. Notice the leaves of tulips, hyacinths, beets, turnips, and of bulbs and plants generally whose roots do not spread in a horizontal direction, and it will be found that their leaves usually assume a position more or less like that shown in Figure 93. Their edges are apt to curve inwards and they slope from base to apex at such an angle as to carry most of the water that falls upon them straight to the axis of growth, and so on down to the root. In most trees and shrubs, on the other hand, and in plants generally with spreading roots, the leaves slope from base to tip so that the water is carried away from the axis to the circumference, where the delicate young root fibers grow that are most active in the work of absorption. In the first case the drainage is said to be *centripetal*, or towards the center of growth; in the second, it is *centrifugal*, or away from the center.



95.— Leaf with tapering point that acts as a gutter in conducting off water.

59. Leaf Cups. — The water could not well run down a long, slender leaf stalk from the blade to the stem, hence, in plants fitted for centripetal drainage the leaves are generally sessile, or the petioles are grooved or appendaged in various ways, as in the winged leaf stalks of the sweet pea and the common leaf cup (*Polymnia*), which takes its name from the cuplike expansion into which the base of the petiole is often dilated. Connate leaves may also serve the same purpose. Can you think of any other probable use for these natural water holders? Why, for



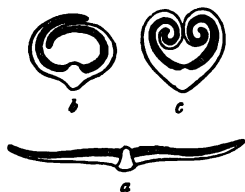
96.—Winged petiole of *Polymnia*.



97.—Water cups of *Silphium perfoliatum*.

instance, do housewives sometimes set the feet of their cupboards in vessels of water ?

60. Protection against Excessive Light and Heat. — With plants growing in very hot, dry climates, or in exposed situations, it is often necessary to guard against too rapid



98.—Cross sections of the leaf of sand grass: *a*, unrolled in its ordinary position; *b* and *c*, rolled up to prevent too rapid transpiration.

transpiration by shutting off the direct rays of the sun from the stomata, just as we close our blinds in summer to keep the heat out. The common blackberry lily (*Belamcanda*) of our old red hillsides, and others of the iris family, to which it belongs, have their leaves ranged vertically so as to expose only the tips to the full glare of the noonday

sun. Many swamp herbs like the sweet flag (*Acorus Calamus*), the cat-tails, and yellow-eyed grass (*Xyris*) have the same habit, the pools and marshes in which they grow often becoming dry in summer ; and moreover, even though there may be plenty of moisture, they are very dependent upon it and need to retain a good store. Strongly revolute margins, such as are found in many sand plants growing along the seashore, produce the same effect by inclosing the stomata in the hollow trough or cylinder formed by their recurved edges.

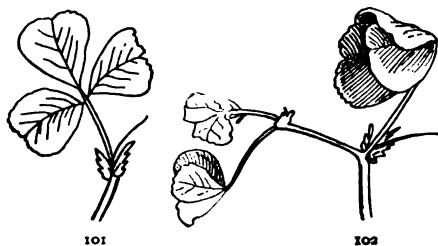
61. Compass Plants.—A very remarkable adjustment is that of the rosinweed, or compass plant (*Silphium laciniatum*), which grows in the prairies of Alabama and westward, where it is exposed to intense sunlight. The leaves not only stand vertical, but have a tendency to turn their edges north and south so that the blades are exposed only to the gentler morning and evening rays. The prickly lettuce manifests the same habit.



99, 100.—A compass plant, rosinweed (*Silphium laciniatum*): 99, seen from the east; 100, seen from the south.

62. Leaves that go to Sleep.—The leaves of many plants change their position at night as if folding themselves for sleep. This habit is

especially noticeable in certain members of the pea family and also in the wood sorrel and the cultivated oxalis of the gardens. The motions may be either spontaneous, as in the telegraph plant (*Desmodium gyrans*), or in response



101, 102.—Spotted medick: 101, awake; 102, asleep.

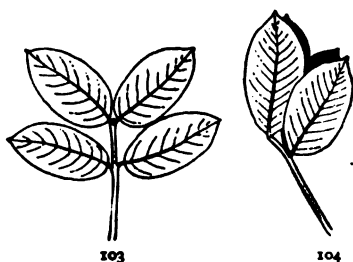
to various external agents, as light, heat, irritation by contact with other substances, etc. The positions assumed are various and may even differ in different parts of the same compound leaf; in

the kidney bean (*Phaseolus*), for instance, the common petiole turns up at night and the separate leaflets down.

63. Experiments.—Place a healthy plant of oxalis, spotted medick, or white clover in a pot and keep it in your room for observation. Notice the changes of position the leaves undergo. Sketch one as it appears at night and in

the morning. Can you think of any benefit a plant might derive from this habit of going to sleep?

In order to determine whether these changes are due to want of light or of warmth, put your plant in a dark closet in the middle of the day, without change of temperature. After several hours note results. Transfer to a refrigerator, or in winter, place outside a window where it will be exposed to a temperature of about 5° C. (40° F.) for several hours, and see if any change takes place. Next put your



103, 104.—Ground pea or peanut:
103, in day position; 104, in night position.

plant at night in a well-lighted room and note the effect. If practicable, keep a specimen for several months in some place where electric lights are burning continuously all night, and try to find out whether it is possible to kill a plant for want of sleep.

64. Autumn Leaves.—When trees prepare for their winter sleep the sap all retires from the foliage back to the stem and roots, and the leaves, having no more work to do, give up their chlorophyll and fall away. It is this breaking up of the chlorophyll by the oxygen of the air, that gives to the autumn woods their brilliant coloring, and not the action of frost. After a wet season, when the leaves are full of sap and nourishing juices, the chemical changes attendant upon the withdrawal of the chlorophyll are more active, and the changes of color more vivid than after a period of drought, when the leaves wither and fall away with little display of color.

65. The Physiological Significance of leaf adjustment will be evident if we consider that the process of food manufacture is entirely dependent upon the action of chlorophyll through the agency of light. Without this agency no food can be produced, though its influence is not always

direct. Seeds germinate, bulbs and rootstocks perform their vegetative functions, and many parasites and saprophytes grow and flourish in the dark, but in these cases it is always at the expense of reserve material provided by the plant itself, or by the host, through the agency of chlorophyll acting in the light.¹ It is the green leaves of summer that lay up the stores of food in bulbs and rootstocks for winter, and flowering stems will even grow and blossom in the dark if enough green leaves are left exposed to manufacture nourishment for them.

Pass the end of a budding flower stem of any green-leaved plant — gourd, squash, water melon, morning-glory, etc., make good examples — through a small hole



105. — A gourd plant developed partly in the dark and partly in the light.

into a dark box, leaving the rest of the plant exposed to light, and taking care not to bruise or injure it in any way. Cover the entire leafy portion of another plant of the same kind with a box, leaving only the flower bud exposed, and covering, or cutting away any new leaves that may appear. Watch what happens, and at the end of two or three weeks compare results. The green plant may not show any change for several weeks, until it has used up the chlorophyll already stored away in its leaves.

Experiments like the foregoing show that it is no mere figure of rhetoric to speak of the coal hidden away in the earth as “stored up sunshine.”

¹ Recent discoveries have given reason to believe that a few of the bacteria are exceptions to this statement, but with regard to the generality of plants, it holds true.

PRACTICAL QUESTIONS

1. Why are the outer twigs of trees generally the most leafy? (54, 55, 56.)
2. Is the common sunflower a compass plant? Is cotton?
3. Are there any such plants in your neighborhood?
4. Compare the leaves of half a dozen shade-loving plants of your neighborhood with those of as many sun-loving ones; which, as a general thing, are the larger and less incised?
5. Give a reason for the difference. (53, 56.)
6. Why do most leaves — notably grasses — curl their edges backwards in withering? (17, 60.)
7. What advantage is gained by doing this? (60.)
8. Observe such of the following plants as are found in your neighborhood, and report any changes of position that may take place in their leaves and the causes to which such changes should be ascribed: wood sorrel, mimosa (*Albizia*), honey locust, wild senna (*Cassia Marilandica*), partridge pea (*C. Chamæchrista*), wild sensitive plant (*C. nictitans*), red bud, bush clover (*Lespedeza*), Japan clover (*L. striata*), Kentucky coffee tree, sensitive brier (*Schrankia*), ground pea or peanut, kidney bean.
9. Which of the trees named below shed their leaves from tip to base of the bough (centripetally), and which in the reverse order? Ash, beech, hazel, hornbeam, lime, willow, poplar, pear, peach, sweet gum, elm, sycamore, mulberry, China tree, sumac, chinquapin.

TRANSFORMATIONS OF LEAVES

MATERIAL. — Any kinds of leaves that can be obtained showing adaptations for protective and other purposes, such as scales, spines, tendrils, glands, etc. Some of those mentioned in the text are: sweet pea, cedar, cactus, asparagus, cabbage, stonecrop, purslane, sarracenia, bladderwort (*Utricularia*), sundew (*Drosera*), Spanish bayonet (*Yucca*), stinging nettle (*Urtica*), horse nettle (*Solanum Carolinense*). The subject is best studied out of doors, or in a greenhouse.

66. Besides performing their natural functions, leaves are modified in various ways to do the work of other organs. No part of the plant is subject to more curious and varied metamorphoses, and they are made to serve all sorts of purposes.

67. **Leaves as Tendrils.** — Examine a leaf of the wild vetch, or of the common garden pea, and it will be seen

that the two or three upper leaflets are transformed into tendrils for climbing. In the sweet pea all but the two lowest leaflets have been developed into tendrils.



106. — Leaf of common pea, showing upper leaflets reduced to tendrils.

68. Scale Leaves. —

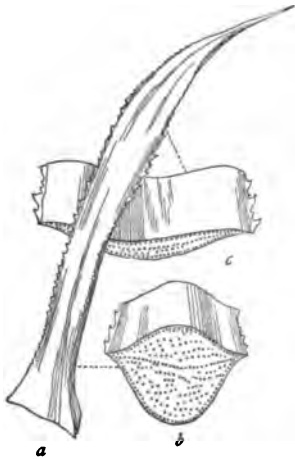
Sometimes the leaf disappears entirely, or is reduced to a mere scale or spine, as in the cedar and most cactuses, and some other part takes its place, but it can always be recognized by its position on the stem, just below the point where a bud appears. Ordinarily, buds never occur anywhere except at the axil, and this

position is so constant that it will generally serve to distinguish leaves from other organs under all disguises. In the common asparagus, the green threadlike appendages which are usually regarded as foliage, spring each from the axil of a little scale. This, as has just been stated, is the normal position of a bud or branch, and hence, botanists conclude that here a double transformation has taken place, of leaves into scales and branches into foliage.

Scale leaves are of use to plants that have need to protect themselves against frost and snow, like the heaths and mosses of cold regions. They are common also in hot and arid districts where it is necessary to reduce the surface exposed for transpiration, though here they are more apt to take the form of prickles and spines as a double protection against sun and animals.

69. Leaves as Storehouses of Food and Moisture. — Of this we have familiar examples in the cabbage and other

salad plants of the garden. In some of the fleshy stone-crops and purslanes, the leaves seem to have transformed themselves into living water bags.



107. — *a*, Leaf of an agave, or American aloe, thickened for the storage of water; *b* and *c*, cross sections made at points indicated by the dotted lines.

70. Death Traps. — The *sarracenia*, better known as the pitcher plant, or trumpet leaf, is a familiar example of these vegetable insect catchers. Its curious pitcher-shaped, or trumpet-shaped leaves are traps for the capture of the small game upon which the plant feeds. The lower part of the blade is transformed into a hollow vessel for holding water, and the top is rounded into a broad flap called the *lamina*. Sometimes

the lamina stands erect, as in the common yellow trumpets of our coast regions, and when this is the case, it is brilliantly colored and attracts insects. Sometimes, as in the parrot-beaked and the spotted trumpet leaf (Fig. 108), it is bent over the top of the water vessel like a lid, and the back of the leaf, near the foot of the lamina, is dotted with transparent specks that serve to decoy foolish flies away from the true opening and tempt them to wear themselves out in futile efforts to escape, as we often see them do against a window pane.

If the contents of one of these leaves are examined with a lens there will generally be found mixed with the water at the bottom, the remains of the bodies of a large number of insects. Notice that the hairs on the outside all point up, towards the rim of the pitcher,



108. — Spotted *sarracenia* (*S. variegata*): *l*, lamina; *s*, transparent spots (after GRAY).

while those on the inside turn downward, thus smoothing the way to destruction but making return impossible to a small insect when once it is ensnared. When we remember that these plants are generally found in poor, barren soil, we can appreciate the value to them of the animal diet thus obtained.

71. Other Examples of insect-catching leaves are the Venus's flytrap, found nowhere but in a certain section of North Carolina, near the coast, and the little sundew (*Drosera rotundifolia*), which Mr. Darwin has made the heroine of his famous book on "Insectivorous Plants." It is a delicate, innocent looking little flower, and owes its poetic name to the dewlike appearance of a shining, sticky fluid exuded from the glands on its leaves, which glitter in the sun like diamond dewdrops. It is, however, a most



109. — Plant of sundew.



110. — Leaf of sundew expanded.



111. — Leaf closing over captured insect.



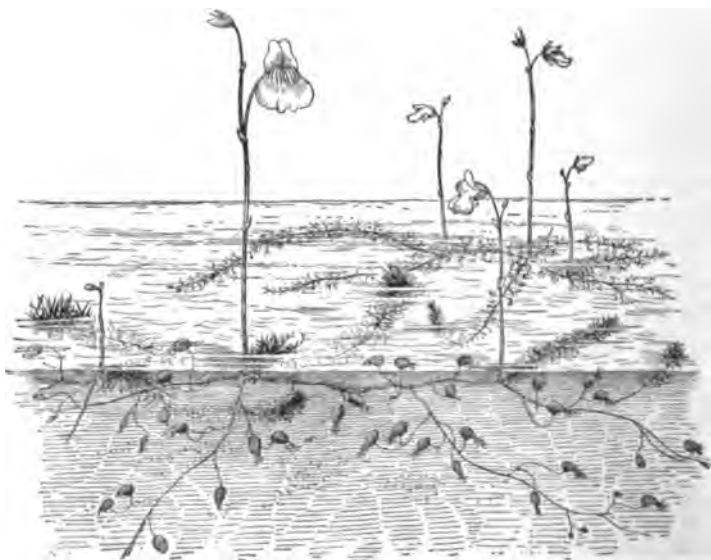
112. — Sundew leaf digesting a meal.

110-112. — Leaves of sundew magnified.

voracious carnivorous plant, the shining, sticky leaves acting as so many bits of fly paper by means of which it catches its prey. When a fly has been trapped, the edges

of the leaf curve inwards, making a little pouch or stomach, and an acid juice exudes from the glands and digests the meal. After a number of days, varying according to the digestibility of the diet, the blades slowly unfold again and are ready for another capture.

In the bladderwort, common in pools and still waters nearly everywhere, the petioles are transformed into floats, while the finely dissected, rootlike blades bear little bladders which, when examined under the microscope, are found to contain the decomposed remains of captured animalculæ.



113. — Bladderwort, showing finely dissected submerged leaves bearing bladders for capturing animalculæ.

72. Protective Leaves. — One of the most frequent modifications of leaves is for protection, either of themselves or of other organs, against animals, drought, excessive moisture, dust, heat, cold, etc. The prickles of the thistle and horse nettle, the hairs of the stinging nettle, and the sharp spears from which the Spanish bayonet (*Yucca aloifolia*) takes its name, are all familiar examples of the first kind, as are also the venom of the poison ivy,

the fetid odors of the jimson weed and China tree, and even the aroma of the pennyroyal and lavender that we pack with our clothes in summer to keep the moths away.



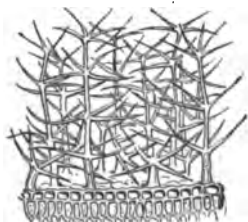
114.—Protective awl-pointed leaves of Russian thistle.



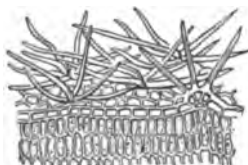
115.—Spine protected leaf of horse nettle.



116.—Spearlike leaves of Spanish bayonet.



117. *Verbascum thapsiforme*.



118. *Potentilla cinerea*.



119. *Shepherdia*.

117-119.—Protective hairs magnified.

The protective devices of leaves are generally so apparent that the student can easily make them out for himself, with the help of a few suggestive questions.

PRACTICAL QUESTIONS

1. How can it benefit a plant to have its leaves, or some of them, changed to tendrils? (67.)
2. What advantage to plants is it to be able to climb? (54-57, 65.)
3. Why is it that evergreen trees and shrubs have generally either thick, hard, coriaceous leaves, like those of the holly and magnolia, or scales and needles, as in the cedar and pine? (68.)
4. Why are winter herbs with tender foliage, like the chickweed and winter cress, generally low stemmed, and disposed to keep close to the earth?
5. Why do many plants which are *deciduous* — that is, shed their leaves in winter — at the north, tend to become evergreen at the south?
6. Question 5 seems to conflict with question 13, page 27; can you reconcile them?
7. Can you find any kind of leaf that is not preyed upon by something? If so, how do you account for its immunity?
8. Make a list of some of the most striking of the protected leaves of your neighborhood.
9. What is the nature of the protective organ in each case?
10. For protection against what does it seem to be specially adapted?
11. Are the plants in your list for the most part useful ones, or troublesome weeds?
12. Examine the leaves of the worst weeds that you know and see if these will help in any way to account for their persistency.

FIELD WORK

The study of this subject and of all those that follow should be supplemented by field work, in expeditions organized for the purpose; furthermore, the student can learn a great deal for himself by keeping his eyes open and observing the plants he meets with in his ordinary walks.

In connection with Sections 14-30, consider the effects upon soil moisture of water transpiration from the leaves of forest trees that strike their roots deep, and from those of shallow-rooted herbs and weeds that draw their water supply from the surface. Consider the value of forests in protecting crops from excessive evaporation by acting as wind breaks. Study the effect of the fall of leaves on the formation of soil.

In any undisturbed forest tract turn up a few inches of soil with a garden trowel and see what it is composed of. Notice what kind of plants grow in it. Note the absence of weeds and account for it. Compare the appearance of trees scattered along windy hillsides, where the fallen leaves are constantly blown away, or in any position where the soil is unrenewed, with those in an undisturbed forest, and then give an opinion as to the wisdom of hauling away the leaves every year from a timber lot.

Sections 31-49. Observe the effect of the lobing and branching of leaves in letting the sunlight through. Notice any general differences that may appear as to shape, margin, and texture in the leaves of sun plants, shade plants, and water plants, and account for them. Study the arrangement of leaves on stems of various kinds and see how it is adapted in each case to the shape of the foliage. Consider the value of the various kinds of foliage for shade; for ornament; as producers of moisture; as food; as insect destroyers, etc.

It is important to learn to know and distinguish the different kinds of trees and shrubs in your neighborhood by their leaves. A useful exercise for this purpose is to make a collection of those of some family like the oaks or hawthorns, that contains a great many varieties, and compare them carefully with one another.

Sections 50-65. In different mosaics and rosettes of leaves study the means by which the adjustment has been brought about and the purpose it subserves. Notice the form and position of petioles of different leaves, and their effect upon light exposure, drainage, etc., and the behavior of the different kinds in the wind. Look for compass plants in your neighborhood, and for other examples of adjustment to heat and light. Study the position of leaves at different times of day and in different kinds of weather and note what changes occur and to what they are due. The sunflower and pea families offer some of the most striking examples of this kind of sensitiveness. The oxalis and geraniums, cotton, and others of the mallow family ought also to be investigated.

Study the drainage system of different plants and observe whether there is any general correspondence between the leaf drainage and the root systems. This will lead to interesting questions in regard to irrigation and manuring. (Where plants are crowded the growth of both roots and leaves is complicated with so many other factors that it is best to select for observations of this sort specimens growing in more or less isolated situations.)

Notice the time of the expansion and shedding of the leaves of different plants, and whether the early leafers, as a general thing, shed early or late; in other words, whether there seems to be any general time relation between the two acts of leaf expansion and leaf fall.

Sections 66-72. Look for instances of protected leaves; study the

nature and position of the protective organs and decide as to their special purpose, whether as defenses against heat, cold, dust, or insects and other animals. Examine the tendrils of various climbing plants and tell from their position whether they represent stipules, leaves, or branches. Look for instances of transformed leaves of any kind and try to understand the nature and object of the transformation. Always be on the alert for transformations and disguises everywhere, and account for them as far as you can.

III. FRUITS¹

FLESHY FRUITS

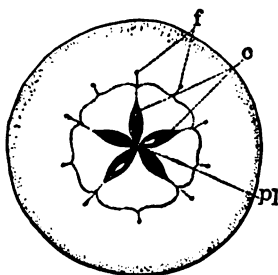
MATERIAL. — Apple, pear, haw, hip, or other pome fruit; any kind of melon or gourd fruit (if a specimen of the turban squash can be obtained it will illustrate well the morphology of this kind of fruit); tomato, cranberry, lemon, grape, or other kind of berry; a pickled peach or cherry, or some kind of wild drupe, as dogwood or black haw. City schools can obtain specimens for the lessons in this chapter from fruit stores, and teachers can do a great deal by collecting and preserving material when on their summer outings.

73. What is a Fruit? — The word fruit does not mean exactly the same thing to the botanist that it does to the gardener and the farmer. Botanically, a fruit is any ripened seed vessel, or *ovary*, as it is technically named, with such connected parts as may have become incorporated with it; and so, to the botanist, a boll of cotton, a tickseed, or a cockle bur is just as much a fruit as a peach or a watermelon.

74. The Pome. — Examine an apple or pear. With the point of a pencil separate the little dry, pointed scales that cover the depression in the center of the end opposite to the stem. These are the remains of the *sepals*, or lobes of the little green cup called a *calyx* that will be found at the base of all apple and pear blossoms in spring. Their

¹ It may seem a little premature to begin the study of fruits here, as some kinds cannot be fully understood without examining them in connection with the flower, but the desirableness of taking them up at a season when material is abundant seems to the author more than an offset to this objection. It will be found a great advantage, moreover, to familiarize the pupil with the structure of the ripened ovary, where the parts are large and easy to distinguish, before taking up the study of that organ in the flower, where it is often so small that it can not conveniently be dissected.

nature will be more apparent on comparing them with a hip, which is clearly only the end of the footstalk enlarged and hollowed out with the calyx sepals at the top. Cut

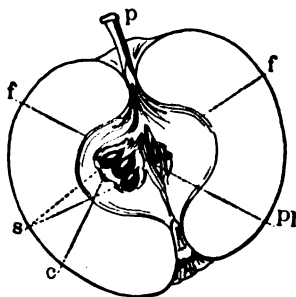


120.—Cross section of a pome: *pl*, placenta; *c*, carpels; *f*, fibrovascular bundles.

a cross section midway between the stem and the blossom ends, and sketch it. Label the thin, papery walls that inclose the seed, *carpels*. How many of them are there, and how many seeds does each contain? The carpels taken together constitute the *pericarp*, or wall of the seed vessel. The

fleshy part of the apple is, strictly speaking, no part of the seed vessel or ovary proper, but consists merely of the receptacle, or end of the footstalk, which becomes greatly enlarged and thickened in fruit. The word *pericarp*, however, is often taken in a broader sense, to include all that portion of the fruit which surrounds and adheres to the ovary, no matter what its nature or texture. Look for a ring of dots outside the carpels, connected (usually) by a faint scalloped line. How many of these dots are there? How do they compare in number with the carpels? With the remnants of the sepals adhering to the blossom end of the fruit?

75. Next make a vertical section through a fruit, and sketch it. Notice the line of woody fibers outside the carpels, inclosing the core of the apple. Compare this with your cross section; to what does it correspond? Where do these threads originate? Where do they end? Can you make out what they are? (See Section 43; they are the fibrovascular bundles that connected the veins in the petals



121.—Vertical section of a pome: *p*, peduncle; *f*, fibrovascular bundles; *s*, seeds; *pl*, placenta; *c*, carpel.

and sepals of the apple blossom with the stem.) Notice how and where the stem is attached to the fruit. Label the external portion of the stem *peduncle*, the upper part, from which the fibrovascular bundles branch, the *torus*, or *receptacle*. It is the enlargement of this which forms the fleshy part of the fruit.¹ Try to find out, with the aid of your lens and dissecting pins, the exact spot at which the seeds are attached to the carpels, and label this point *placenta*. Notice whether it is in the axis where the carpels all meet at their inner edges, or on the outer side. Observe, also, whether the seed is attached to the placenta by its big or its little end. If you can find a tiny thread that attaches the seed to the carpel, label it *funiculus*, or seed stalk.

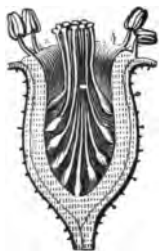
76. Use of the Rind.—Select two apples of equal size, peel one, and then weigh both. After twelve to twenty-four hours, weigh them again. Which has lost most? What is the use of the rind? Place peeled and unpeeled fruits in an exposed place and see which is most readily attacked by insects. Which decays soonest?

Write under the sketches that you have made the word *pome*, which is the botanical name for this kind of fruit. Write a definition of a pome.

77. Modifications of the Pome.—Compare with the drawings you have made, a haw and a hip. What points of agreement do you see? What differences? Which of the two more closely resembles the typical pome?

The pome is not the only fruit of which the receptacle forms a part. Other well-known instances of this sort of modification are the fig, lotus, and calycanthus (see Figs. 123, 124); but a fruit is not a pome unless the containing receptacle becomes more or less soft and edible. The receptacle is subject to a great variety of modifications and forms a part of many fruits.

¹ See *Pome*, "American Encyclopedia of Horticulture," Macmillan Co.



122. — Vertical section of a hip, showing seeds contained in a hollow receptacle (after GRAY).



123



124

123, 124. — Enlarged receptacle of Carolina allspice (*Calycanthus*) containing fruits attached to its inner surface: 123, exterior; 124, vertical section.

78. The Pepo, or Melon. — Next examine a gourd, cucumber, squash, or any kind of melon, and compare its blossom end with that of the pome. Do you find any remains of a calyx, or other part of the flower? Examine the peduncle and observe how the fruit is attached to it. Cut cross and vertical sections, and sketch them, labeling each part. There may be some difficulty in making out the carpels, for they are not separate and distinct as in the pome, but confluent with the enlarged receptacle, which in these fruits forms the outer portion of the rind,¹ and also with each other at their edges, so as to form one unbroken circle, as if they had all grown together. And



125. — Cross section of gourd: *c*, one of the carpels in diagram (after GRAY).

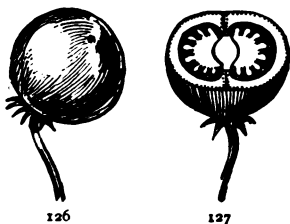
this is precisely what has happened. The number of carpels can easily be distinguished, however, by counting the placentas, which divide the interior into compartments called *cells* or *loculi*, corresponding in number to the number of carpels. The placentas are greatly enlarged and modified, and it may be necessary to refer to the diagram, Figure 125, in order to make them out. How many cells, or chambers, are there in your specimen? How many placentas? Are the seeds vertical, as in the apple, or horizontal? Look

¹ See *Cucurbita*, "American Encyclopedia of Horticulture."

for the little stalk, or thread, that attaches them to the placenta.

Pepo is the name given by botanists to this kind of fruit. Write in your notebook a proper definition of it, from the specimens examined.

79. The Berry. — Examine a tomato, an eggplant, a grape, cranberry, lemon, or orange, in both cross and vertical section, and compare it with the pepo. Notice that they all agree in having a more or less thick and firm outside covering filled with a soft, pulpy interior. In what respects does the one you are examining differ from the pepo?



126, 127. — A potato berry:
126, exterior; 127, cross section.

Fruits of this kind are classed by botanists as berries. They are the commonest of all fleshy fruits, and the most variable and difficult to define.



128, 129. — Tangerine: 128, vertical section;
129, cross section.

In general, any soft, pulpy, or juicy mass, like the grape and tomato, whether one or many seeded, inclosed in a containing envelope, whether skin or rind, is a berry. Its typical forms are such fruits as the grape,

mistletoe, pokeberry, etc., though such diverse forms as the eggplant, persimmon, red pepper, orange, banana, and pomegranate have been classed as berries; and, in fact, the pepo itself is only a greatly modified kind of the same fruit. In popular language, any small, round, edible fruit is called a berry, but do not confound it with

80. The Drupe, or stone fruit, of which the cherry, plum, peach, dogwood, black haw, and black gum furnish typical examples.

Notice that the drupe agrees with the berry in having

a more or less juicy or fleshy interior surrounded by a protecting skin, but the stone within this is not a mere



130. — Vertical section of a drupe (after GRAY).

seed, such as we find in the berry, but consists of the inner layer of the pericarp, which has become hard and bony. Open the stone and the seed will be seen with its own coverings inside. Have you ever found a stone with more than one kernel to it; for instance, in eating almonds? This fact shows that the stone is not a seed coat, but

the hardened inner wall of a seed vessel or ovary; for a seed coat can never contain more than one seed any more than the same skin can contain more than one animal. In a green drupe, before the stone has hardened, its connection with the fleshy part is very evident. This stony layer enveloping the seed is the main distinction between the drupe and the berry, and it is not always possible to make it out except by an examination of the young ovary. Of course there can be but one stone to a carpel, as each carpel has only one inner coat to be hardened; but where a drupe is composed of several carpels clustered together, as we saw them in the apple, each one may produce a stone from its inner coat while the outer coats become confluent, as in the melon, and in this way a drupe may be several seeded, as is actually the case in the dogwood, elder, etc.

All the fruits that have been considered in Sections 73-80 belong to the class of fleshy ones. These form the great bulk of the fruits sold in the market and served upon our tables, and are of special importance to the horticulturist.

PRACTICAL QUESTIONS

1. Examine such of the fruits named below as you can obtain, and tell to which of the four kinds described each belongs: asparagus, horse nettle, China berry, smilax, hackberry, pawpaw, guava, persimmon, red pepper, orange, buckeye, gherkin, pumpkin, prickly pear, mangrove, whortleberry, banana, date, olive, maypop, cedar berry, Ogeechee lime.
2. Which are the commonest of fleshy fruits in autumn?

3. Name six of the most watery fruits that grow in your neighborhood.
4. Under what conditions as to soil, heat, moisture, etc., does each thrive best?
5. Would a gardener act wisely to infer that because a fruit contains a great deal of water it should be planted in a very wet place?
6. Which contains most water, the fruit or the leaves of the apple?
7. Why does the fruit not wither when separated from the tree, as the leaves do? (76.)

DRY FRUITS

MATERIAL.—Acorn or other nut; a cotton boll or a pea or bean pod; various small, seedlike fruits, such as the so-called seeds of the sunflower, carrot, parsley, clematis, grains of corn, etc.

81. Importance of Dry Fruits.—Dry fruits are not in general so conspicuous or attractive as fleshy ones, but on account of their greater number and variety they offer a wide field for study. And when we consider that the grains which furnish our breadstuffs, and the beans and nuts that form so large a part of our food all belong to this class we realize that they have an even greater claim upon our attention than the most brilliant products of the garden.

82. Different Kinds of Dry Fruits.—Compare an acorn, a chestnut, or a hazelnut with a ripe cotton boll or a bean pod. Try to open each with your fingers; what difference do you perceive?

This difference gives rise to the distinction of dry fruits into

83. Dehiscent: those that open at maturity in a regular way for the discharge of their seed; and

84. Indehiscent: those that remain closed until the dry carpels are worn away by decay, or burst by the germination of the contained seed.

85. Why Some Fruits Dehisce.—Open each of your specimens; how many seeds, or kernels, does the indehiscent one contain? The dehiscent one? Can you explain

now why the one should open and the other not? Would it be of any advantage for a one-seeded pod to open? Remove the kernel from the indehiscent fruit; has it any covering besides the shell? Which is the pericarp, and which the seed coat?

86. Indehiscent Fruits are so simple that it will not be necessary to devote much time to them. Gather specimens of as many kinds as you can find, and try to identify them by means of the pictures and descriptions that follow. Do not try to memorize these descriptions, but use them merely as a help in studying actual specimens. The acorn, hickory nut, chestnut, etc., furnish good examples of

87. The Nut, which is easily recognized by its hard, bony covering, containing usually, when mature, a single large seed that fills the interior. Care must be taken not to confound with true nuts, large bony seeds, like those of the buckeye, horse-chestnut, date, and the Brazil nut sold



131



132



133



134

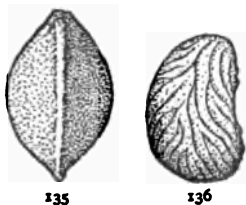
131, 132.—Nut of the pecan tree:
131, exterior; 132, cross section.

133, 134.—Nutlike seeds: 133, horse-chestnut; 134, seed of *sterculia foetida*.

in the markets. In the true nut the hard covering is the seed vessel, or pericarp, and no part of the seed itself, though it often adheres to it so closely as to seem so. In bony seeds like those of the horse-chestnut and persimmon the hard covering is the seed coat. The distinction is not always easy to make out unless the seed can be examined while still attached to the placenta of the fruit.

88. The Akene, of which we have examples in the tailed fruit of the clematis, the tiny pits on the strawberry, and

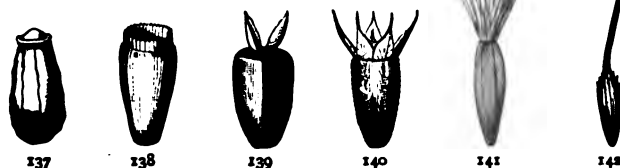
the so-called seeds of the thistle, dandelion, etc., is a small, dry, one-seeded indehiscent fruit,



135, 136.—Akenes (magnified): 135, of buckwheat; 136, of cinquefoil.

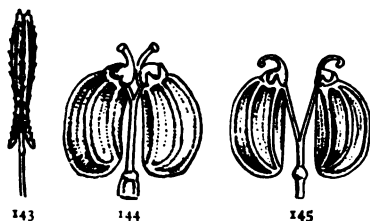
so like a naked seed that it is generally taken for one by persons who are not acquainted with botany. It is the commonest of all fruits, and there are so many kinds that special names have been applied to some of the most marked varieties. The akene of the composite family may generally be

known by the various appendages in the form of scales, hooks, hairs, or chaff, that crown it (Figs. 137–142). This appendage is always called a *pappus*, no matter under what form it occurs. It is fre-



137–142.—Akenes of the composite family (GRAY): 137, mayweed (no pappus); 138, chicory (its pappus a shallow cup); 139, sunflower (pappus of two deciduous scales); 140, sneezeweed (*Helenium*), with its pappus of five scales; 141, sow thistle, with its pappus of delicate downy hairs; 142, dandelion, tapering below the pappus into a long beak.

quently deciduous, as in the sunflower, and sometimes wanting altogether, as in the mayweed.

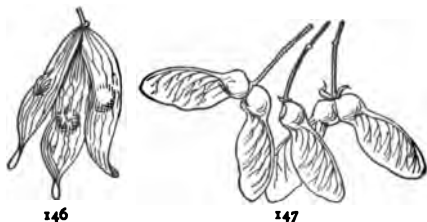


143–145.—Cremocarps, fruits of the parsley family.

89. **Cremocarp** is the name given to the fruit of the parsley family. It is merely a sort of double akene attached by the inner faces to a

slender stalk called the *carpopphore*, or carpel bearer, from

which it separates at maturity. Gather a fruiting cluster of fennel, parsley, caraway, etc., and examine one of the small seedlike fruits through a lens. Separate the two akenes of which it is composed, and find the carpophore between them. Sometimes it splits in two (Fig. 145), one half going with each achene; or they may separate from it through their entire length and remain suspended from the top (Fig. 144). Notice the longitudinal ribs on the back of the akenes, or *mericarps*, as they are called. Between these ridges are situated the *vittæ*, or oil tubes to which the aromatic flavor of these fruits is due.



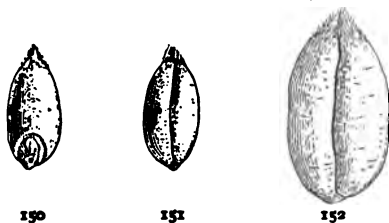
146, 147. — Samaras: 146, ailanthus; 147, maple.

The maple, ash, elm, etc., furnish familiar examples.

91. The Grain, or caryopsis, so familiar to us in all kinds of grasses, is a modification of the akene in which the seed coats have so completely fused with the pericarp that they can no longer be distinguished as separate organs. Peel the husk from a grain of corn that has been soaked for twenty-four hours, and you will find the



148, 149. — Grain of broom corn millet with husks on: 148, front view; 149, back view.



150-152. — Grain of wheat: 150, back view; 151, front view; 152, front view (magnified).

contents exposed without any covering; remove the shell of an acorn or a hickory nut, and the seed will still be enveloped by its own coats. Would it be any advantage for the seed of an indehiscent fruit, like a grain of corn or oats, to have a special covering of its own?

92. Distinction between Nuts and Akenes.—In very small fruits it is not easy to distinguish between a nut and an akene, nor is it very material. Technically, an akene is a fruit composed of a single carpel, a nut of two or more which have become so completely fused together that their separate parts can be detected only by examining the unripe seed vessel in the flower. Botanists apply the terms very loosely, and the beginner need not be distressed if he can not classify exactly all the specimens he meets with. In general, the larger, harder, and bonier fruits of the kind are called nuts. The family to which a specimen belongs must also be taken into consideration. For instance, the akene being the characteristic fruit of the sunflower family, any puzzling specimen of that family, like the cockle bur, would naturally be classed as an akene.

PRACTICAL QUESTIONS

1. Name all the indehiscent fruits you can think of that are good for food or other purposes.
2. Make a list of the commonest indehiscent fruits of your neighborhood.
3. Which of these are useful for any purpose?
4. Which are troublesome weeds?

DEHISCENT FRUITS

MATERIAL.—Simple follicles of larkspur, milkweed, etc.; a pod of pea or bean; pods of any species of the mustard family, or of the trumpet vine (*Tecoma*); cotton, okra, iris, or Indian shot (*Canna*). Cotton or okra are preferable if they can be obtained, because the parts are large and well defined.

93. Simple, or Monocarpellary Fruits.—Pod, or capsule, is the general name given to all dehiscent fruits. The latter term is properly confined to pods of more than one carpel, but the distinction is not strictly observed by botanists. The simplest possible kind of a pod is

94. The Follicle, of which the larkspur, milkweed, marsh marigold, etc., are familiar examples. It is composed of

a single carpel, which may be regarded as a modified leaf.



153.—Follicle of milkweed.

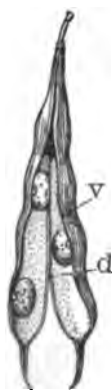
Examine one of these pods and you will find that it splits down one side, which corresponds to the edges of the leaf brought together and turned inwards to form a placenta for the attachment of the seed. This line of union is called a *suture*, from a Latin word meaning a seam.

95. The Carpel a Transformed Leaf. —

The leaflike nature of the carpel is very evident in such fruits as the follicles of the Japan varnish tree (*Sterculia plataniifolia*), where even the veining is quite distinct, and the whole carpel so leaflike in appearance that there is no mistaking its nature. Indeed, after the wonderful transformations we have already found leaves undergoing, their development into the hardest and thickest of carpels need not surprise us.



154.—Leaflike follicle of Japan varnish tree: *s, s*, sutures.



155.—Legume of bean: *v*, ventral suture; *d*, dorsal suture.

96. The Legume. — Get a pod of any kind of bean or pea, and observe that it differs from the follicle in having two sutures or lines of dehiscence. One of these, which runs along the back of the carpel and corresponds to the midrib of the leaf, is called the outer, or *dorsal*, suture; the other, corresponding to the united edges of the carpellary leaf, is the inner, or *ventral*, suture, so called because it always turns inwards, that is, towards the center or axis of the flower.

97. Origin of the Name.—This kind of pod is the characteristic fruit of the great pea, or pulse family, and gets its name from the Latin word, *lego*, to pick, or gather, because crops of pulse have always been picked by hand instead of being cut or mown like grain and hay.

98. Sutures.—Place a legume upon one side and sketch it, labeling the sutures. If you cannot tell which is the dorsal and which the ventral, open the pod and observe where the seeds are attached; this is the ventral suture, because in all normal carpels it is the united edges of the leaf margins, or in other words, the ventral suture, that forms the seed-bearing surface, or placenta.

99. Valves.—Sketch the open pod with the seeds in it, showing their point of attachment. Label this the *placenta*, and the two halves into which the pod has split, *valves*. Notice that the valves are not separate carpels, but only two halves of the same carpel. What is the difference between a legume and an ordinary follicle?



156. — Constricted legume of *Cassia Nelsoni*.



157. — Legume of a pea, with partially constricted pod.

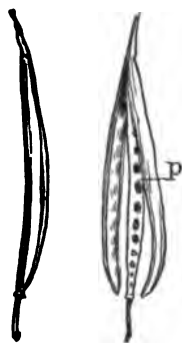


158. — Loment of beggar's ticks.

100. The Loment, so unpleasantly familiar to most of us in the beggar's ticks tribe, is merely a kind of legume constricted between the seeds and breaking up into separate joints at maturity. What kind of indehiscent fruits do the joints resemble when separated?

101. The Silique is the characteristic fruit of the mustard family, as the legume is of the pea tribe, though it is

common in other plants also, the trumpet flower (*Tecoma radicans*) being a conspicuous example. Open any convenient specimen and notice the manner of dehiscence. How does it differ from that of the legume? What other difference do you perceive? Are the edges of the valves reflexed or folded in any way so as to form the two cells or chambers into which the silique is divided? How is the partition made? A dividing wall of this sort, that is made in any other way than by the inflexed margins of the carpels, is called a *false partition*. Sketch your specimen as it appears with one of the valves removed, showing the position and attachment of the seeds.



159, 160.—Silique of mustard: 159, closed; 160, after dehiscence, showing false partition, *p*.

Where is the placenta? Is the false partition parallel with the valves or at right angles to them? Compare it in this respect with other specimens of the same family, and with the silique of the trumpet vine, if you can get one; is the direction of the partition always the same? Does it fall away with the valves or remain

attached to the receptacle?

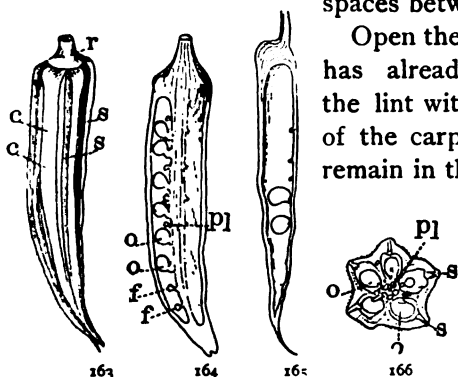
102. The Silicle is only a short and broad silique, like those of the shepherd's purse (*Capsella Bursa-pastoris*) and pepper grass (*Lepidium*). The last two named belong to the class known as



161, 162.—Silicle of shepherd's purse: 161, entire; 162, with one carpel removed, showing attachment of seeds, and the false partition running contrary to the flattened sides.

103. Syncarpous or Compound Pods.—Generally speaking, there are never more carpels in a pod than there are seed-bearing sutures. In a boll of cotton, or a pod of okra, iris, or other large dehiscent fruit, notice the lines or seams running from base to apex of the pericarp; into how many sections or carpels do they divide it? When several carpels unite in this way into one body, they form a *syncar*

pous pod or capsule—the word “syncarpous” meaning “of united carpels.” The three large, leaflike bodies at the base of the cotton boll (none in the okra — unless very immature pods are used — or the iris) are *bracts*, and together they form an *involucre*. Remove these and also the remains of the flower cup, or calyx, that will be found just within them, and notice the round, flattish expansion of the stem where the fruit is attached. Make a sketch of the closed capsule, labeling this expansion *receptacle*, the stem itself *peduncle*, the longitudinal lines *sutures*, and the spaces between them *carpels*.



163-166. — Capsule of okra: 163, entire, *c, c*, carpels, *r*, receptacle, *s, s*, sutures; 164, vertical section, *pl*, placenta, *o, o*, ovules, *f, f*, funiculus, or seed stalk; 165, single carpel; 166, cross section, *pl*, placenta, *o, o*, ovules, *s, s*, sutures.

Open the boll, or take one that has already dehisced, remove the lint with the seed from two of the carpels, allowing them to remain in the others, and sketch

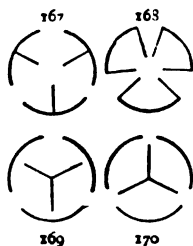
the whole as it appears on the inside. Notice the protruding ridge down the center of each carpel which divides the fruit, when closed, into separate chambers or cells. Find out

to what part the seeds are attached and label it *placenta*. The little threadlike stalks that attach the seed are very small and hard to distinguish from the fleece, but when they are broken away, their place can generally be detected by small, toothlike projections on the placenta.

In pods like those of okra, cotton, iris, etc., the placenta is said to be *parietal*, from a Latin word meaning a wall, because it projects from the wall of the seed vessel. From which suture does it arise, the dorsal or the ventral? Which kind of sutures are those shown on the exterior of the boll? (Secs. 94, 98). Does it dehisce by the dorsal or the ventral sutures? Notice that when a capsule splits

along its dorsal sutures in this way, the segments into which it divides are made up of the two contiguous halves of adjacent carpels, just as if we should fasten a number of leaves together by their edges and then split them down their midribs, we should get an equal number of sections made up of the adjacent halves of different leaves. And on the supposition that carpels are altered leaves, this is precisely what happens in the case of syncarpous capsules such as we have been examining.

104. Modes of Dehiscence.—Make a diagram of the mode of dehiscence of your specimen, and compare it with that of a pod of the castor bean, jimson weed, St. John's-wort, flax, etc.; or if specimens cannot be obtained, with the accompanying diagrams. What difference do you perceive in their modes of dehiscence? The first of these is called



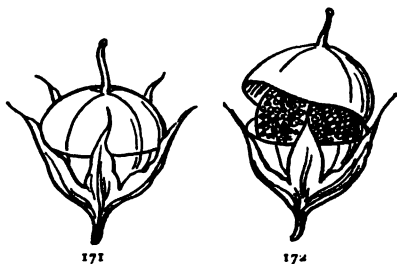
167-170.—Diagrams of dehiscence (after GRAY): 167, loculicidal; 168, septicidal; 169 and 170, septifragal.

105. Loculicidal (Fig. 167), because it splits through the back of the carpels directly into the cells or *loculi*, a word meaning "little chambers." The second is

106. Septicidal, that is, the dehiscence takes place through the *septa*, or partitions that divide the cells (Fig. 168). Either of these modes may become

107. Septifragal, as in the morning-glory, where the carpels break away from the division walls, leaving them attached to the axis of the fruit (Figs. 169 and 170). Another common form is the

108. Circumscissile, in which the upper part of the pod comes off like the lid of a dish, as in the purslane, plantain, henbane, amaranth, etc.



171, 172.—Circumscissile capsule of *Anagallis*: 171, closed; 172, open.

109. Union of Carpels. — The carpellary leaves may unite either by their open edges, as if a whorl like that represented in Figure 77, were to grow together by the margins (Fig. 173); or each may first roll itself into a simple follicle like the larkspur and columbine (Fig. 175), and then a number of these may unite by their ventral sutures into a single syncarpous



173

173. — Plan of one-celled ovary formed by the union of open carpellary leaves (GRAY).



174

174. — Cross section of one-celled syncarpous capsule of frostweed, with parietal placentae (GRAY).



175

175. — Follicles of larkspur borne on the same torus, but distinct.

capsule, with as many cells as there are carpels (Fig. 177). The seed-bearing sutures being all brought together in the center, the placenta becomes *central* or *axial*. In the first



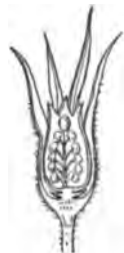
176

176. — Pods of Echeveria, contiguous, but distinct.



177

177. — Capsule of Colchicum, with carpels united into a syncarpous pod.

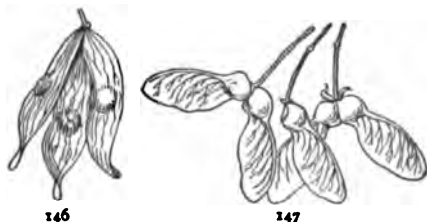


178

178. — Capsule of corra cockle, with free axile placenta.

case (Fig. 174) the open carpels form a one-celled capsule, though the placentas sometimes project, as in the cotton and okra, so far as to produce the effect of true partitions with central placenta (Fig. 164). In one-celled capsules,

which it separates at maturity. Gather a fruiting cluster of fennel, parsley, caraway, etc., and examine one of the small seedlike fruits through a lens. Separate the two akenes of which it is composed, and find the carpophore between them. Sometimes it splits in two (Fig. 145), one half going with each achene; or they may separate from it through their entire length and remain suspended from the top (Fig. 144). Notice the longitudinal ribs on the back of the akenes, or *mericarps*, as they are called. Between these ridges are situated the *vittæ*, or oil tubes to which the aromatic flavor of these fruits is due.



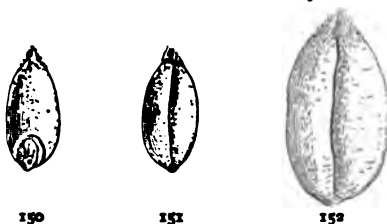
146, 147.—Samaras: 146, ailanthus; 147, maple.

The maple, ash, elm, etc., furnish familiar examples.

91. The Grain, or caryopsis, so familiar to us in all kinds of grasses, is a modification of the akene in which the seed coats have so completely fused with the pericarp that they can no longer be distinguished as separate organs. Peel the husk from a grain of corn that has been soaked for twenty-four hours, and you will find the



148, 149.—Grain of broom corn millet with husks on: 148, front view; 149, back view.



150-152.—Grain of wheat: 150, back view; 151, front view; 152, front view (magnified).

contents exposed without any covering; remove the shell of an acorn or a hickory nut, and the seed will still be enveloped by its own coats. Would it be any advantage for the seed of an indehiscent fruit, like a

grain of corn or oats, to have a special covering of its own?

92. Distinction between Nuts and Akenes.—In very small fruits it is not easy to distinguish between a nut and an akene, nor is it very material. Technically, an akene is a fruit composed of a single carpel, a nut of two or more which have become so completely fused together that their separate parts can be detected only by examining the unripe seed vessel in the flower. Botanists apply the terms very loosely, and the beginner need not be distressed if he can not classify exactly all the specimens he meets with. In general, the larger, harder, and bonier fruits of the kind are called nuts. The family to which a specimen belongs must also be taken into consideration. For instance, the akene being the characteristic fruit of the sunflower family, any puzzling specimen of that family, like the cockle bur, would naturally be classed as an akene.

PRACTICAL QUESTIONS

1. Name all the indehiscent fruits you can think of that are good for food or other purposes.
2. Make a list of the commonest indehiscent fruits of your neighborhood.
3. Which of these are useful for any purpose?
4. Which are troublesome weeds?

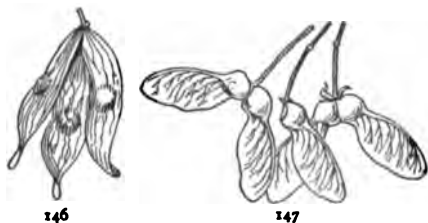
DEHISCENT FRUITS

MATERIAL.—Simple follicles of larkspur, milkweed, etc.; a pod of pea or bean; pods of any species of the mustard family, or of the trumpet vine (*Tecoma*); cotton, okra, iris, or Indian shot (*Canna*). Cotton or okra are preferable if they can be obtained, because the parts are large and well defined.

93. Simple, or Monocarpellary Fruits.—Pod, or capsule, is the general name given to all dehiscent fruits. The latter term is properly confined to pods of more than one carpel, but the distinction is not strictly observed by botanists. The simplest possible kind of a pod is

94. The Follicle, of which the larkspur, milkweed, marsh marigold, etc., are familiar examples. It is composed of

which it separates at maturity. Gather a fruiting cluster of fennel, parsley, caraway, etc., and examine one of the small seedlike fruits through a lens. Separate the two akenes of which it is composed, and find the carpophore between them. Sometimes it splits in two (Fig. 145), one half going with each achene; or they may separate from it through their entire length and remain suspended from the top (Fig. 144). Notice the longitudinal ribs on the back of the akenes, or *mericarps*, as they are called. Between these ridges are situated the *vittæ*, or oil tubes to which the aromatic flavor of these fruits is due.



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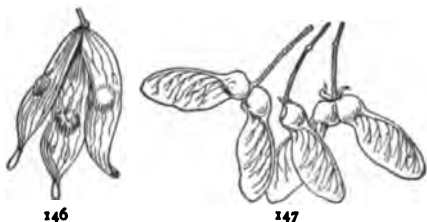
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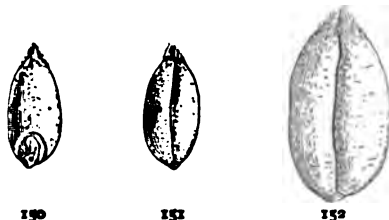
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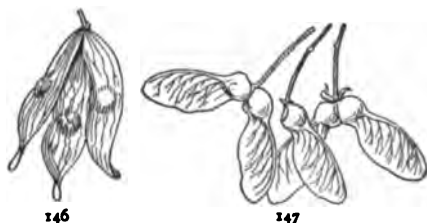
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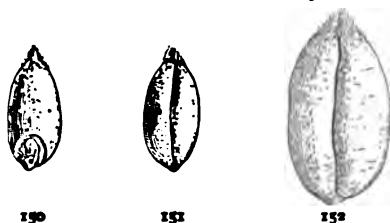
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DEHISCENT FRUITS

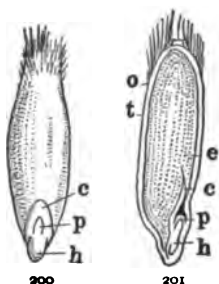
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remove the plumule with the hypocotyl from the cotyledon, and sketch it. Make a vertical section of another soaked grain at right angles to its broader face, and sketch it, labeling the parts as they appear in profile. Make a cross section through the middle of another grain, and sketch it. (A very sharp instrument must be used in making sections, or they will not be satisfactory.) What proportion of the grain is endosperm and what embryo?

It has been seen that one of the effects of iodine is to turn starch blue, or even black (Sec. 26). Put a drop on some of the endosperm and note the effect. Of what does it consist? Test the seed coats in the same way to see if they contain any starch.



200, 201. — Dissection of a grain of oats: 200, entire, and slightly enlarged, showing *c*, cotyledon, *p*, plumule, *h*, hypocotyl; 201, vertical section, *c*, cotyledon, *e*, endosperm, *p*, plumule, *h*, hypocotyl.

119. Study of a Typical Small Grain. — Make a similar examination of a grain of oats or wheat. Compare the endosperm of a soaked grain with that of an unsoaked one; what change has taken place and how do you account for it? Test with iodine and see what it consists of. Which contains the greater proportion of endosperm, wheat (or oats) or corn?

Notice that both the kinds of grain just examined have but one cotyledon, hence, such seeds are said to be *monocotyledonous*. The grains are not typical seeds (Sec. 91), but are selected for examination because they are large and easy to obtain, and germinate readily. Other monocotyledonous seeds should be examined if practicable. The blackberry lily (*Belamcanda*) and iris furnish good examples.

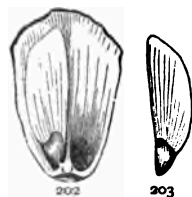
120. Polycotyledons. — Remove one of the scales from a pine cone and sketch the seed as it lies in its place on the cone scale. The seed with its wing looks very much

like a samara of the maple, but it differs from all forms of the achene in being a true seed and not a fruit. Notice that the pine has no closed seed vessel, or ovary, like the other specimens we have been considering, but bears its seed naked in the axil of the cone scales, which may be considered open carpels. Hence, plants of this kind are called *Gymnosperms*, a word that means "naked seeds."

Look at the bottom, or little end of the seed, with your lens, for a small opening like a pin hole. Make an enlarged drawing of the seed as it appears under the lens, labeling this hole *micropyle*, a Greek word meaning "a little gate," because it is the entrance to the interior of the seed.



204. — Section of pine seed, showing the polycotyledonous embryo (GRAY).



202, 203. — Pitch pine seeds (GRAY): 202, scale, or open carpel, with one seed in place; 203, winged seed, removed.

Remove the coat from a seed that has been soaked for twenty-four hours, and examine it with a lens. Pick out the embryo from the endosperm. Does the endosperm resemble that of the corn and wheat? Test it with iodine for starch. How does the embryo differ from those already examined? How many cotyledons are there?

Plants having more than two seed leaves are said to be *polycotyledonous*, a word meaning "having many cotyledons." This structure is characteristic of the pines, firs, hemlocks, and some other plants, mostly belonging to the *Gymnosperms*, or naked-seeded class.

PRACTICAL QUESTIONS

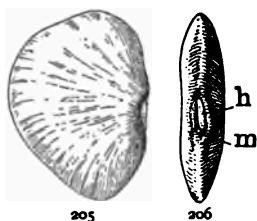
1. What gives to Indian corn its value as food? To oats; wheat; barley; rye; rice? (118, 119.)
2. Which of these grains have the larger proportion of starch or other endosperm to the embryo?
3. Do the husks or seed coats contain any nourishment?

4. Is there any nourishment in the embryos, apart from the endosperm?
5. What is bran?
6. Why will hogs fatten in a pine thicket in autumn?

DICOTYLEDONS

MATERIAL.—Dry and soaked seeds of the common bean, cotton, and castor bean. Where cotton can not be obtained, okra, maple, ash, morning-glory, or any other convenient specimens may be used, provided they are selected so as to show both the albuminous and the ex-albuminous structure. Squash, pumpkin, horse-chestnut, etc., also make good studies. Beans should be put to soak from 12 to 24 hours before used; cotton about 48; squash and pumpkin from 3 to 5 days, and very hard seeds like the okra, castor bean, and morning-glory from 7 to 10. If such seeds are *clipped* before soaking, that is, if a small piece of the coat is chipped away from the end opposite the scar, they will soften more quickly. Keep them in a warm place with an even temperature till just before they begin to sprout, when the contents become softened. Very brittle cotyledons may be softened quickly by boiling them for a few minutes.

121. Examination of Some Typical Seeds.—Take a bean from the pod, noticing carefully its point of attachment. Lay it on one side and sketch it, then turn it over and draw the narrow edge that was attached to the pod. Notice the rather large scar (commonly called the eye of the bean) where it broke away from the point of attachment. Label this in your drawing, *hilum*. Just below the hilum, look for a minute round pore like a pin hole. Label this *micropyle*. Compare a soaked bean with a dry one; what difference do you perceive? How do you account for the change in size and hardness? Find the hilum and the micropyle in the soaked bean. Make a section

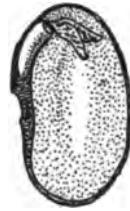


205, 206.—A kidney bean: 205, side view; 206, raphal view, showing *h*, hilum, *m*, micropyle.

through the long diameter at right angles to the flat sides, press it slightly open and sketch it. Notice the line or slit that seems to cut the section in half longitudinally, and

the small round object between the halves at one end; can you tell what it is?

Slip off the coat from a whole bean and notice its texture. Hold it up to the light and see if it shows any signs of veining. See whether the scar at the hilum extends through the kernel, or marks only the seed coat. Does the coat seem to adhere to the kernel more firmly at one point than another? If so, label this point *chalaza*. Lay open the two flat bodies into which the kernel divides when stripped of its coats. Sketch their inner face and label them *cotyledons*. Be careful not to break or displace the tiny bud packed away between the cotyledons, just above the hilum. Label the round, stem-like portion of this bud, *hypocotyl*, and the upper, more expanded part, *plumule*. Which way does the base of the hypocotyl point, toward the micropyle, or away from it? Pick out this budlike body entire and sketch as it appears under the lens. Open the plumule with a pin and examine it with a lens; of what does it appear to consist? Do you find any endosperm around the cotyledons as in the corn and oats? Break one of the soaked cotyledons, apply some iodine to it, and report whether it contains any starch. Where is the nourishment for the young plant stored? What part of the bean gives it its value as food?



207. — Cotyledon of a bean, showing plumule.

Notice that in the bean the embryo consists of three parts, the hypocotyl, plumule, and cotyledons, which completely fill the seed coats, leaving no place for endosperm.

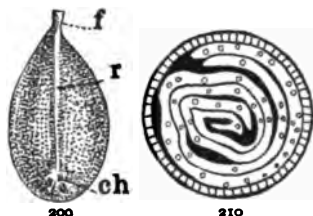


208. — Cotton seed with lint.

122. Dissection of a Cotton Seed. — (Where cotton can not be obtained, morning-glory, okra, or maple may be used.)

Scrape the lint from a seed of cotton as closely as possible, or if practicable, get a specimen of one of the smooth seeded varieties in cultivation, and look for a faint line or

groove on one side, leading from the small end to the big end. Make a sketch of the side showing this line, label it *rhaphe*, and the point where it begins, at the large end of the seed, *chalaza*. Look for the hilum at the other



209, 210. — Dissected cotton seed.
209, seed with lint removed (magnified three times), *f*, funiculus, or seed stalk, *r*, rhaphe, *ch*, chalaza; 210, cross section of the seed still more highly magnified, showing the crumpled cotyledons.

end of the rhaphe, and for the micropyle near it, at the small end of the seed. If they can not be distinguished on account of the lint, make a longitudinal section of a well-soaked seed and find where the hypocotyl points. Which way did it point in the bean? This is the case with all seeds; the base of the hypocotyl is towards the micropyle, and so we can

always tell where the micropyle is by noticing which way the hypocotyl points. Make an enlarged sketch of the section as it appears under the lens, and also of a cross section of another soaked seed about midway between the two ends, showing as accurately as you can the lines of any folds or convolutions that you may see. Label such parts as you can clearly make out, leaving the others till after further examination.

From a seed that has been boiled for five or ten minutes to soften the contents, gently remove the coats so as to leave the embryo whole. How many seed coats are there? How do they differ in color and texture? Try to distinguish them in the sketches you have made, and label the hard outer one that corresponds to the shell of an egg, *testa*, the soft inner one, *tegmen*. What is the use of each? As the coats were removed did they seem to adhere to the kernel more tenaciously at one point than elsewhere? Look for a little dark spot inside near the base, that marks where the seed coats and kernel adhered together. Refer to your sketch of the out-



211. — Embryo with cotyledons partly unfolded.

side of the seed, and say to what it corresponds. Are the chalaza and micropyle close together, as in the bean, or at opposite ends of the seed?

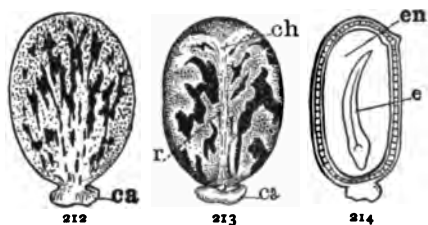
Sketch the kernel, or embryo, without opening it, as it appears under the lens. Notice the irregular fold or groove down one side that divides it into two nearly equal parts. Label these *cotyledons*. Observe the complicated way in which they are folded. Try to imitate it with a piece of paper. Would any other way of folding fit them so snugly into the seed coats? Straighten them out as well as you can and sketch them. Which are most leaf-like, the cotyledons of the bean or the cotton? Are either of them at all similar in shape to the foliage leaves of their respective plants? How do they compare in size relatively to the size of the respective seeds? Which are best fitted to perform the office of true leaves?

In seeds like the pea and bean, where the cotyledons are too thick and clumsy to do well the work of true leaves the young plant will need a well-developed plumule to begin life with, but where the cotyledons are thin and leaflike, as in the cotton, and to a less degree in the pumpkin and squash, and capable of developing quickly into true leaves, there is generally no plumule formed in the embryo.

123. The Castor Bean. — Lay a castor bean on a sheet of paper before you with its flat side down; what does it look like? The resemblance may be increased by soaking the seed a few minutes, in order to swell the two little protuberances at the small end. Can you think of any benefit a plant might derive from this curious resemblance of its seed to an insect?

Sketch the seed as it lies before you, labeling the protuberance at the apex, *caruncle*. The caruncle is no essential part of the seed, but a mere appendage developed by various plants, the use of which is not always clear. What appears to be its object in the castor bean? It may occur on any part of the seed, though it generally

takes some other name when borne elsewhere than at the micropyle, of which it is usually an outgrowth.



212-214. — Castor bean (slightly magnified): 212, back view; 213, front view, *ch*, chalaza, *r*, rhaphe, *ca*, caruncle; 214, vertical section, *e*, embryo, *en*, endosperm.

Turn the seed over and sketch the other side. Notice the colored line or stripe that runs from the large end to the caruncle. This represents the rhaphe. Its

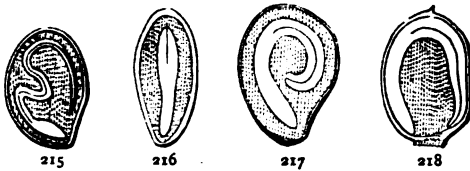
starting point near the large end, which is marked in fresh seeds by a slight roughness, is the chalaza. Where the rhaphe ends, just at the beak of the caruncle, you will find the hilum. The micropyle is covered by the caruncle, which is an outgrowth from it.

Next cut a vertical section through a seed that has been soaked for several days, at right angles to the broad sides, and sketch it. Label the thick outer coat *testa*, the delicate inner one *tegmen*, the white, pasty mass within that, *endosperm*. Can you make out what the narrow white line running through the center of the endosperm, dividing it into two halves, represents? Make a similar sketch of a cross section. Notice the same white line running horizontally across the endosperm, dividing it into two equal parts. To find out what these lines are, take another seed (always use soaked seeds for dissection) and remove the coats without injuring the kernel. Notice the little dark spot where it was joined to the coats at the chalaza. Split the kernel carefully round the edges, remove half the endosperm, and sketch the other half with the delicate embryo lying on its inner face. You will have no difficulty now in recognizing the lines in your drawings as sections of the thin cotyledons. Where is the hypocotyl, and which way does its base point? Remove the embryo from the endosperm, separate the cotyledons with a pin, and hold them up to the light to see their beautiful texture.

Sketch them under the lens, showing the delicate venation. Is there any plumule?

Test the endosperm with a little iodine to see if it contains any starch. Crush a bit of it on a piece of white paper and see if it leaves a grease spot. What does this show that it contains? Test the embryo in the same way, and see whether it contains any oil.

124. Arrangement of the Embryo. — Notice the difference in the way the embryo is packed in the castor bean, and in such seeds as the cotton, okra, and maple. In the former it is said to be *straight*, while in the latter it is



215-218. — Arrangement of embryo in endosperm (GRAY): 215, morning-glory; 216, barberry; 217, potato; 218, four o'clock.

folded or *plicate*. In different seeds it may be coiled and folded in many different ways. It may also be packed within the endosperm, as the castor embryo, or coiled or wrapped around it, as in the chickweed.

125. Storage of Nourishment in the Seed. — In the various seeds examined we have seen that the nourishment for the young plant is either stored in the embryo itself, as in the cotyledons of the bean, acorn, squash, etc., or packed about them in the form of endosperm, as in the corn, wheat, and castor bean.

The latter are classed by botanists as *albuminous*, the former as *ex-albuminous*—the word “albumin” referring not to the chemical composition of the food supply, but to its office, which is similar to that of the albumen, or white of the egg stored up for the nourishment of the hatching chick. The older botanists, recognizing the analogies between the seed and the egg, and not understanding the true nature of either, regarded the seed as a sort of vege-

table egg, and named the reserve material we now call endosperm, albumen. It is now known to be something very different, however, from the white of an egg. Frequently it is starch, as we have seen in the corn, wheat, oats, etc., or it may be an oil, as in the castor bean and peanut, or something quite different from either. Hence, modern botanists have renamed this substance endosperm, a word meaning merely something contained "within the seed," and therefore applicable to any kind of substance. The old adjectives, albuminous and ex-albuminous, have been retained for want of something better — ex-endospermous being such an awkward compound that even botanists hesitate to use it.

By far the greater number of seeds are albuminous; that is, they consist of an embryo with more or less nourishing matter stored about it in various ways. Even in ex-albuminous seeds the endosperm is present; it has merely been absorbed and stored in the cotyledons before germination.

126. Principles of Classification. — We are now prepared to understand the great fundamental distinctions upon which botanists base their classification of *Spermatophytes*, or seed-bearing plants. The first division depends upon the presence or absence of a seed vessel, and ranges all the higher plants into two classes according to this feature. The first division embraces the

127. Gymnosperms, or naked-seeded plants, of which we have had an example in the pine. They are the most primitive type of seed-bearing plants and the most ancient. Though they are not so abundant now as in past ages, numbering only about four hundred known species, they present many diversities of form, which seem to ally them on the one hand with the lower, or spore-bearing plants (ferns, mosses, etc.), and on the other with the

128. Angiosperms, or plants that produce their seeds in a special covering of closed carpels, like most of the fruits

and pods that we have been considering. This group contains all the true flowering plants, and forms the most important part of the vegetation of our globe, numbering not less than one hundred thousand species. It is divided into two great groups, distributed, as we have seen, according to the number of their cotyledons, into

129. Monocotyledons and Dicotyledons. — These are further distinguished by the fact that dicotyledons have, as a general thing, net-veined, and monocotyledons, parallel-veined leaves. The cause of this difference, science has never yet been able to explain, so that for the present we shall have to accept it as a fact which we can not understand. There are other differences, also, in the structure of the flower and the stem, which will be considered later.

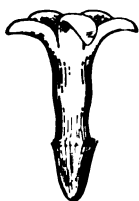
PRACTICAL QUESTIONS

1. Make a list of all the seeds you can think of that have very thick cotyledons.
2. Draw a line under all that are used as food by man or beast.
3. Could a species derive any advantage from tempting animals to eat and destroy its seed? (117.)
4. What then is the advantage to the plant of providing this food supply? (125.)
5. Do you find any edible seeds without protection, and if so, account for their want of it.
6. Make a list of all the albuminous seeds you can think of that are used for food or other purposes, such as medicines and unguents.
7. Do you find as many food materials among these as among the ex-albuminous kind?
8. Are they in general as well protected as ex-albuminous seeds?
9. How do the two compare, in a general way, as to size?
10. What part of the following plants do we eat, the fruit or the seed? Corn; wheat; hickory nut; cocoanut; Brazil nut; peanut; beechnut; string beans; honey locust; coffee; anise; celery.
11. From what part of the castor bean do we get the oil? Of the peanut? Of the cotton seed?
12. What gives to cotton-seed meal its value as cattle food?
13. Is there any valid objection to the wholesomeness of peanut oil, and cotton-seed lard?

FORMS AND GROWTH OF SEED

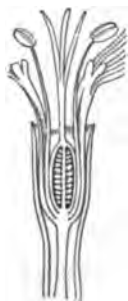
MATERIAL. — Various kinds of pods and fruits with the seed still attached to the placentas, such as the following. Straight seeds: buckwheat, smilax, dock, knotweed. Inverted: castor bean, cotton, violet, magnolia, cherry, apple, and the majority of common seeds. Curved: bean, purslane, jimson weed, okra, and most of the pink family.

130. Erect Seeds. — The most natural, and at the same time the least common mode of attachment is for a seed to stand erect upon its stalk like a pink or a rosebud on its stem. A seed that grows in this manner is said to be *orthotropous* (Figs. 220, 221). If we imagine the seed coats to be separated from each other and from the embryos, as in the diagram (Fig. 220), we shall see that the parts all come together and coalesce at the base, where they are attached to the seed stalk, just as all the parts of a flower adhere at the receptacle (Fig. 221). This point,

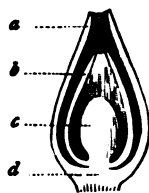


219. — An erect flower, showing attachment of the stalk.

the organic base of the seed, is the chalaza, and



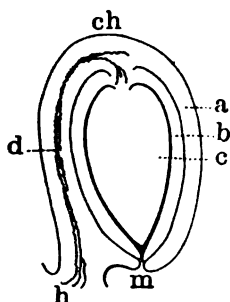
221. — Section of an upright flower, showing insertion of parts at base (after GRAY).



220. — Diagrammatic section of a typical or orthotropous seed (GRAY), showing the outer coat, *a*; the inner, *b*; the nucleus, *c*; the chalaza, or place of junction of these parts, *d*.

you can now understand the tendency of the coats of the different seeds examined to cohere there. An inspection of the diagram will show that in orthotropous seeds the hilum and chalaza will always coincide. At the other end, the tip or apex of the seed (Fig. 220), the coats do not quite come together, thus causing the small aperture that we labeled "micropyle" in our drawings. In this arrangement the micropyle will always be opposite the chalaza, and it marks the organic apex of the seed as the chalaza does its base.

131. Inverted Seeds.— But sometimes a flower turns over on its stalk, like the snowdrop and harebell, and the same thing often happens to a seed. This gives rise to the inverted, or *anatropous* kind (Fig. 223). In this case, which is due to certain peculiarities in the early growth of the seed, the stalk does not remain separate like the stem of a pendent flower, but coalesces more or less completely with the coats, and thus forms the rhaphe (Fig. 223), *d*. The chalaza remains at the base, *ch*, which is



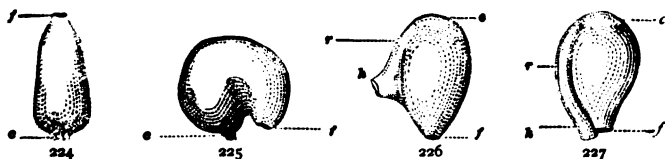
223.—Diagram of an inverted or anatropous seed, showing the parts in section: *a*, outer coat; *b*, inner coat; *c*, nucleus; *d*, rhaphe; *ch*, chalaza; *h*, hilum; *m*, micropyle (after GRAY).

now by inversion at the top; but as the stalk, or rhaphe, is adherent to the coats, it can not break away at the base, and hence, in anatropous seeds the hilum and micropyle are brought close together, at the real apex of the seed. The adherent stalk, or rhaphe, often becomes reduced to a mere line or groove, as we saw in the cotton and castor bean, or may disappear altogether, but the chalaza can generally be distinguished by a tendency of the parts to cohere at that point.



222.—A pendulous flower, showing the inverted position.

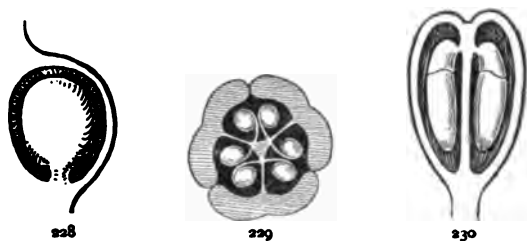
Variations in these modes of attachment are shown in Figures 225, 226. In the campylotropous or curved kind, the seed is bent over during early growth into a circular or kidney shape, so that the micropyle is brought into close



224-227.—Seeds (GRAY): 224, orthotropous seed of buckwheat, *c*, hilum and chalaza, *f*, micropyle; 225, campylotropous seed of a chickweed, *c*, hilum and chalaza, *f*, micropyle; 226, amphitropous seed of mallow, *f*, micropyle, *h*, hilum, *r*, rhaphe, *c*, chalaza; 227, anatropous seed of a violet, the parts lettered as in the last.

juxtaposition with the hilum, as we saw in the bean. How does this differ from the anatropous kind? Compare the seed you have examined and the drawings you have made with Figures 224–227, and see if you can tell to which class each belongs. Why are these distinctions not applicable to corn and other grains? (Sec. 91).

132. Position in the Pericarp.—The terms “orthotropous,” “anatropous,” etc., refer to the position of the seed on its footstalk and have nothing to do with its attachment



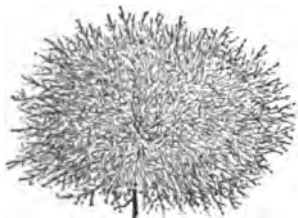
228–230. — Position of seeds in the carpels: 228, erect seed of *Ceanothus*; 229, horizontal anatropous seeds of the European star-of-Bethlehem; 230, suspended seeds of *Polygala*.

to the pericarp, which may be either erect, horizontal, or suspended. An orthotropous seed may hang bottom upwards from the apex of the carpel without altering its character; and in like manner one of the anatropous kind may be attached in such a way as to bring it back, by a double inversion, to the upright position. The castor bean furnishes a good example of this.

133. Seed Dispersal.—This subject has already been touched upon in the chapter on fruits, and the object of distribution is in both cases the same. The agencies of dispersal are either natural, *i.e.* by wind, water, and animals, or artificial, that is, by man.

134. Wind Dispersal.—A common example of wind dispersal is afforded by the class of plants known to farmers as “tumble weeds.” Well-known examples of these are the Russian thistle, winged pigweed, “old witch grass,” hair

grass, etc. Such plants generally grow in light soils and either have very light root systems, or are easily broken from



231. — A fruiting plant of winged pigweed (*Cycloloma*), showing the buncy top and weak anchorage of a typical tumble weed.

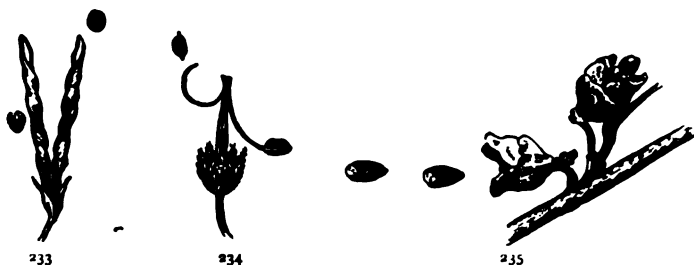


232. — Panicle of "old witch grass," a common tumble weed.

their anchorage and left to drift about on the ground. The spreading, bushy tops become very light after fruiting so as to be easily blown about by the wind, dropping their seeds as they go, until they finally get stranded in ditches and fence corners, where they often accumulate in great numbers during the autumn and winter.

In the Japan varnish tree (*Sterculia platanifolia*) the seeds remain attached all through the winter to the open follicle, which becomes very light when dry, and acts as a sort of float for wafting the seeds away on every breeze.

135. Explosive Capsules. — Some plants undertake to disperse their seeds without the intervention of any external



233-235. — 233, A pod of wild vetch, with mature valves twisting spirally to discharge the seed; 234, pod of crane's-bill discharging its seed; 235, capsules of witch-hazel exploding.

agent. Examples of this kind are the violet, witch-hazel, and touch-me-not, whose capsules dehisce with a little explosion and shoot out the seeds as if they were fairy mortars. It is worth while to gather a bough of witch-hazel in winter and keep it in the schoolroom to watch the explosions. In other cases, the carpels curl upwards with a sudden jerk, as in some of the geranium family, or twist themselves into a spiral, like the valves of the rabbit pea (*Vicia Americana*), thus acting as a spring to eject the seeds.

136. Animal Agency. — Examples of adaptation for dispersal by means of animals were given in Section 117, but by far the most active agent in the dissemination of both fruits and seeds is man. This is the frequent result of intention on his part, in the introduction and cultivation of new grains, fruits, and vegetables, and he works to the same end unconsciously and often to his great detriment by the transportation of the bulbs or seeds of pernicious weeds in the dirt clinging to hoes and plowshares, and the mixture of impurities with his crop seeds through ignorance, carelessness, or unavoidable causes. This mode of dispersal, however, is purely artificial, and except in the case of a few weeds that have adjusted themselves to the conditions of cultivation, is not correlated with any special adaptations in the plants themselves, many of our most widely distributed weeds, such as the rib grass, or common plantain, the mayweed and the narrow-leaved sneezeweed, possessing very imperfect natural means of dispersal.

PRACTICAL QUESTIONS

1. Name the ten most troublesome weeds of your neighborhood.
2. What natural means of dispersal have they?
3. Which of them seem to owe their propagation to man?
4. Are there any tumble weeds in your neighborhood?
5. Should you expect to find such weeds abundant in a hilly or a very woody country?
6. What situations are best fitted for their propagation?
7. Make a list of all the seeds you can think of that are adapted to dispersion by the wind; by water; by animals.

8. Mention some of the ways in which weeds can be propagated by careless farmers.

9. Why are so many strange weeds or other new plants found first along railroad tracks?

10. Account for the absence of weeds in forests and groves.

11. Suggest ways for checking the propagation of weeds, and of stopping their introduction.

GERMINATION

MATERIAL. — Seed of any kind that will germinate readily and with a moderate degree of heat. Corn, oats, cotton, beans, mustard, will any of them answer. Six or eight ordinary preserving jars, or bottles. Some moist cotton, sawdust, or layers of blotting paper, or old flannel. Some vaseline, or, if this is not at hand, lard.

137. Conditions of Germination. — If kept perfectly dry, seed may sometimes be preserved for months, or even years. Peas have been known to sprout after ten years, red clover after twelve, and tobacco after twenty. Ordinarily, however, the vitality of seeds diminishes with age, and in making experiments it is best to select fresh ones. The ones used for comparison should also, as far as possible, be of the same size and weight.

138. Moisture. — Can seeds have too much moisture? To answer this question drop a number of dry grains of corn, oats, or other convenient seed, into a bottle or other vessel with a bedding of cotton or paper that is barely moistened, and an equal number of soaked seeds of the same kind into another vessel with a saturated bedding of the same material. In a third vessel place the same number of soaked seed, covering them partially with water, and in a fourth cover the same number entirely. Label them 1, 2, 3, and 4, and keep all together in a warm and even temperature, and note the rate of germination in the different vessels.

139. Air. — Next arrange in a similar manner a glass jar containing the same kind of seed as before, using a sufficient quantity to fill it at least half full. The vessel should be large enough to hold at least a liter (about one quart). Seal it hermetically so as to prevent the access of

fresh air. Label it 5, and place it with the other four. The water used for soaking the seeds and for moistening the bedding in this experiment should first have had its contained air expelled by boiling.

To test the behavior of seeds in the entire absence of air is difficult, because it is not possible to expel all traces of the atmosphere even with an air pump.

140. Temperature. — Arrange some soaked seeds in three or four different vessels just as in No. 2, in the first experiment, and place where they will be subjected to different temperatures, ranging say from 0° to 30° C. (about 32° to 86° F.). Test frequently with a thermometer, keeping the temperature as even as possible, and maintaining an equal quantity of moisture in each vessel. Keep a record of the number of seed sprouted in each after every twenty-four hours. In those parts of the South where the cold is not continuous enough to keep seed from germinating under ordinary conditions, experiments in low temperatures can not very well be made unless there is a refrigerator available. In sections where there is continuous cold, tests might also be made of the minimum temperature at which different seeds will germinate. Sachs found the minimum for corn to be $9^{\circ}.4$ C. (about 49° F.), and for the gourd, 14° C. (about 58° F.).

141. Recording Observations. — Arrange a page of your notebook after the model given below, and record your

NUMBER OF SEEDS GERMINATED

No. of hours . .		24	48	72	4 d.	5 d.	6 d.	7 d.	8 d.	10 d.	w 2.
No. of vessel . .	1										
No. of vessel . .	2										
No. of vessel . .	3										
No. of vessel . .	4										
No. of vessel . .	5										
No. of vessel . .	6										

observations at intervals of twenty-four hours. When most of the seeds in jar 5 (Sec. 139) have begun to sprout, insert a thermometer and let it remain two or three minutes. Does it indicate any change of temperature? Refer to Section 29 and account for the change. If cotton seed are used, the rise of temperature will be very marked.

142. Vitality.—A very interesting point is to test the temperature at which different seed lose their vitality, by subjecting dry and soaked ones of various kinds to different degrees of heat and cold. Notice how the extremes tolerated are affected by: first, the length of time the seeds are exposed; second, by the amount of water contained in them; and third, by the nature of the seed coats. Every farmer knows that the effect of freezing is much more injurious to plants or parts of plants when full of sap (water) than when dry. This is because in freezing the water expands and ruptures the tissues, thus setting up internal disturbances which are liable to result in death, especially if thawing takes place so rapidly that the life processes have not time to readjust themselves. In like manner it will be found that when seeds are subjected to moist heat, they are killed at a lower temperature and in a shorter time than when dry. When heated in water of the same temperature, those seeds will be found to resist best whose coats are most impervious to the liquid.

143. Time Required for Germination.—Arrange in a bed of moist sand, placed between two soup plates, seeds of various kinds. Good specimens would be some of the following: corn, wheat, peas, cotton, okra, turnip, apple, morning-glory, orange, grape, persimmon, castor bean, peanut, etc. Clip some of the harder ones and place them in the same germinator with unclipped ones. Keep all under similar conditions as to temperature, moisture, etc., and record the time required for each to sprout. What is the effect of clipping, and why?

144. The Relative Value of Perfect and Inferior Seed. — From a number of seeds of the same species select half a

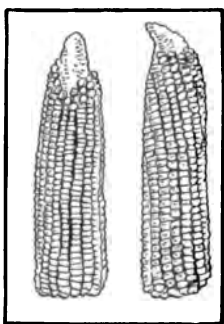


236. — Stem development of seedlings raised from healthy grains of barley; weight, 39.5 grams (about 500 grs.).

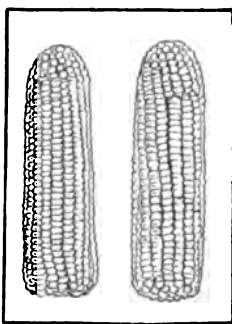


237. — Stem development of seedlings raised under exactly similar conditions from the same number of inferior grains; weight, 23 grams (about 350 grs.).

dozen of the largest, heaviest, and most perfect, and an equal number of small, inferior ones. If a pair of scales is at hand, the different sets should be weighed and a



238



239

238, 239. — Improvement of corn by selection: 238, original type; 239, improved type developed from it.

record kept for comparison with the seedlings at the end of the experiment. Plant the two sets in pots containing exactly the same kind of soil, and keep under identical conditions as to light, temperature, and moisture.

Keep the seedlings under observation for two or three weeks, making daily observations and occasional drawings of the height and size of the stems, and the number of leaves produced by each.

These experiments can be carried on simultaneously with the study of *Seedlings* and *Growth*. It is not

expected that any one class will have time to complete them all, but a number are suggested in order that different teachers may choose the ones best suited to their circumstances.

PRACTICAL QUESTIONS

1. What are the principal external conditions that affect germination? (137, 138, 139, 140.)
2. What effect has cold? Want of air? Too much water?
3. Is light necessary to germination?
4. What is the use of clipping seeds?
5. In what cases should it be resorted to?
6. Why will seed not germinate in hard, sun-baked land without abundant tillage? Why not on undrained or badly drained land? (138, 139.)
7. Will seeds that have lost their vitality swell when soaked?
8. Are there any grounds for the statement that the seeds of plums boiled into jam have sometimes been known to germinate?¹ (142.)
9. Could such a thing happen in the case of apples or watermelons, and why or why not? (142.)
10. Does it make any difference in the health and vigor of a plant whether it is grown from a large and well-developed seed or from a weak and puny one? (144.)
11. Would a farmer be wise who should market all his best grain and keep only the inferior for seed?
12. What would be the result of repeated plantings from the worst seed?
13. Of constantly replanting the best and most vigorous?

SEEDLINGS

MATERIAL.—Seedlings of various kinds in different stages of growth. Those from seeds experimented with in Sections 137-144 may be used to begin with. Corn, oats, bean, squash, cotton, are the ones mentioned in the text. Ash, maple, morning-glory, or castor bean may be used instead of cotton, but the last two are rather difficult to germinate, requiring from 8 to 10 days, or even longer, if the temperature is too low. Soaked seeds of cotton and corn will germinate in from 3 to 7 days, according to the temperature; oats in 1 to 4, beans in 4 to 6, squash in 8 to 10. Germination will be greatly facilitated by soaking the seeds for 12 to 24 hours before planting them, and very obdurate ones may be forced by clipping.

¹ Vines, "Lectures on the Physiology of Plants," p. 282. See also, Sachs, "Physiology of Plants."

A good germinator can be made by putting moist sand or sawdust between two plates. The germinator should be kept at an even temperature of about 20°C. (70° F.). Seeds even of the same kind develop at such different rates that it will probably not be necessary to make more than two plantings of each sort, about 4 or 5 days apart. Enough must be provided to give each pupil 3 or 4 specimens in different stages of development.

145. Seedlings of Monocotyledons.—Examine a grain of corn that has just begun to sprout; from which side does



240, 241. — Seedling of corn (*after* GRAY): 240, early stage of germination; 241, later stage.

the seedling spring, the plain or the grooved one? Refer to your sketch of the dry grain and see if this agrees with the position of the embryo as observed in the seed. Make sketches of four or five seedlings in different stages of advancement, until you reach one with a well-developed blade. Examine each carefully with regard to the cotyledon, the root, and the plumule. Which part first appeared above the ground? In what direction does the plumule grow? The hypocotyl? Does the cotyledon appear above ground at all? Slip off the seed coats and see if there is any difference in the size and appearance of the contents as you proceed from the younger to the older plants. How would you account for the difference?

146. The Cotyledon.—Is the cotyledon of any use to the seedling when it remains in the ground? In order to answer this question, cut away carefully, so as not to injure the plumule, the cotyledon with its endosperm, from a very young seedling, and place on a piece of coarse netting stretched over a glass of water so that its roots will touch the liquid. Put beside it another seedling of the same age and size from which the cotyledon has not been removed, and watch their growth for a week or ten days. Which has developed most rapidly in that time? Test the coty-

ledon on the second seedling for starch ; what has become of it? Test sections of the root and stem of the same seedling and see if any of the starch has gone into them.

147. Growth of the Plumule. — What part of the plumule comes out of the ground first? Is it straight or bent? Open the outer sheath of a well-developed plumule with a needle ; what do you find inside? Examine the plumule of an older plant that has developed several leaves ; where does the second one come from? Look within that for the next one ; from where does the new leaf always seem to proceed? Measure the internodes from day to day and note their rate of growth in your book.

148. Growth of the Root. — Examine the lower end of the hypocotyl and find where the roots originate. Observe their tendency to spread out in every direction, and even to develop from the lower nodes of the hypocotyl ; would you say that the roots are an outgrowth from the stem, or the stem from the root? Mark off a root into sections by moistening a piece of sewing thread with indelible ink and applying it to the surface of the root at intervals of about one millimeter ($\frac{1}{20}$ of an inch). Lay the seedling on a moist bedding in a glass jar, covered lightly to prevent evaporation, and watch to see in what part of the root growth takes place.

Notice the grains of sand or sawdust that cling to the rootlets of plants grown in a bedding of that kind. Examine with a lens and see if you can account for their presence. Lay the root in water on a bit of glass, hold up to the light and look for root hairs ; on what part are they most abundant?



242, 243. — Seedling of corn, marked to show region of growth : 242, early stage of germination ; 243, later stage.

149. Root Hairs are the chief agents in absorbing moisture from the soil. They do not last very long, but are constantly dying and being formed again in the younger and tenderer parts of the root. These are usually broken away in tearing the roots from the soil, so that it is not easy to detect them except in seedlings, even with a microscope. In oat and maple seedlings they are very abundant and clearly visible to the naked eye. The amount of absorbing surface on a root is greatly increased by the presence of the hairs; and they exude, moreover, a slightly acid secretion, which aids them in dissolving and absorbing the mineral substances contained in the particles of earth and sand to which they adhere.



244. — Seedling of wheat, with root hairs.

150. The Root Cap. — Look at the tip of the root through your lens and notice the soft, transparent, crescent or horseshoe-shaped mass in which it terminates. This is the root cap and serves to protect the tender parts behind it as the roots burrow their way through the soil. Being soft and yielding, it is not so likely to be injured by the hard substances with which it comes in contact as the more compact tissue of the roots. It is composed of the loose cells out of which the solid root substance is being formed, and the growing point of the root is at the extremity of the tip just behind the cap (Fig. 245). The cap is very apparent in a seedling of corn, and can easily be seen with the naked eye, especially if a thin longitudinal section is made. It is also well seen in the water roots of the common duckweed (*Lemna*), and on those developed by a cutting of the wandering Jew, when placed in water. Are there any hairs on the root cap?



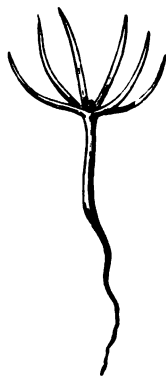
245. — Magnified section of root tip: *c*, root cap; *g*, growing point.

A good way to study the small, delicate parts of plants is to place them between two thin, clear pieces of glass and hold up to the light. Even without a lens many peculiarities of structure can in this way be made apparent to the eye.

Instead of corn, seedlings of wheat or oats may be used, and if time permits it would be well to examine and compare the two.

151. Organs of Vegetation. — These three organs, root, stem, and leaf, are all that are necessary to the individual life of the plant. They are called organs of vegetation in contradistinction to the flower and fruit, which constitute the organs of reproduction. The former serve to maintain the plant's individual existence, the latter to produce seed for the propagation of the species, so we find that the seed is both the beginning and the end of vegetable life.

152. Polycotyledons. — The pine is very difficult to germinate, requiring usually from 18 to 21 days, but if a seedling can be obtained it will make an interesting study. By soaking the mast for 24 hours and planting in damp sand kept at an even temperature of not less than 23° C. (74° or 75° F.) a few specimens may be obtained.



246. — Seedling of pine (GRAY).

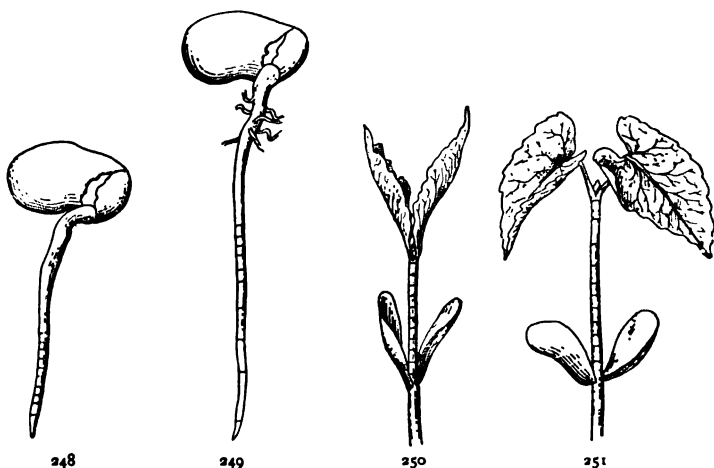
153. Seedlings of Dicotyledons. — Sketch, without removing it, a bean seedling that has just begun to show itself above ground; what part is it that protrudes first? Sketch in succession four or five others in different stages of advancement. Notice how the hypocotyl is arched where it breaks through the soil. Can you account for this? Does it occur in the monocotyledons examined? Almost all dicotyledons exhibit this peculiarity in germination; can you see what causes it? Do the cotyledons appear above ground? How do they get out? Can you perceive

any advantage in their being dragged out of the ground backwards in this way rather than pushed up tip foremost? What changes have the cotyledons undergone in the successive seedlings? Remove from the earth a seedling just beginning to sprout and sketch it. From what point does the hypocotyl protrude through the coats? Does this agree with its position as sketched in your study of the seed? In which part of the embryo does the first growth seem to have taken place?

247.—Seedlings of bean in different stages of growth: *cc*, cotyledons, showing the plumule and hypocotyl before germination; *a*, *b*, *d*, and *e*, successive stages of advancement. At *d* the arch of the hypocotyl is beginning to straighten; at *e* it has entirely erected itself.

Remove in succession the several seedlings you have sketched and note their changes. How does the root differ from that of the corn and oats? Look for root hairs; if

there are any, where do they occur? Mark off the root of a young seedling into sections as directed in Section 148, and



248, 249.—Root of bean seedling, measured to show region of growth: 248, early stage of germination; 249, later stage.

250, 251.—Stem of bean seedling, measured to show region of growth: 250, early stage of growth; 251, later stage.

watch it from day to day. In what part does growth take place? Mark off a node of the stem in a similar manner and find out how it grows. Allow a seedling to develop until it has put forth several leaves, and measure daily the successive internodes. Does an internode stop growing when the one next above it has formed? When is growth most rapid? Reverse the position of a number of seedlings that have just begun to sprout and watch what will happen. A good way to observe the growth of roots is to fill a glass jar or a lamp chimney with moist cotton or sawdust, and insert the seedling between the side of the jar and the moist filling.

154. Cotton.—Examine a number of cotton seedlings in different stages of growth. What part appears above ground first? How does this compare with the first appearance of the bean? Of corn and oats? Pull up a seedling that has just begun to sprout; does the root come from the big or the little end of the seed? Does this agree with what you learned about the position of the hypocotyl in Sections 121 and 122? Notice how the coats adhere at the chalaza, even after the cotyledons are well above ground; is this woolly nightcap of any special service to a delicate plant like the cotton? Notice the little speckled glands that cover the stem and the cotyledons. What change of color do the latter undergo as the seedling develops? How do they compare as foliage leaves with those of the bean, squash, etc.? With the foliage leaves of the mature cotton plant? Of what use to a plant are the cotyledons when they appear above ground? To answer this question cut away the cotyledons from a number of seedlings as soon as they appear, and observe the result as compared with others that have not been cut.

Pull up a seedling and sketch it entire, showing the long, straight taproot. How does it compare in length with that of the bean? How do both differ from those of the corn and oats? Measure the growth of the root and

stem as you did in the bean. Reverse the position of a number of seedlings, so that the hypocotyl shall point upward and the plumule downward, and watch the effect upon their growth. After a few days reverse them again and note the effect. In sections where cotton seed can not be obtained, maple, ash, morning-glory, or squash, pumpkin, etc., may be substituted.

PRACTICAL QUESTIONS

1. Do the cotyledons, as a general thing, resemble the mature leaves of the same plants?
2. Try to account for the difference, if you observe any; could convenience of packing in the seed coats, for instance, have anything to do with it?
3. If seeds are planted in the ground in a number of different positions, will there be any difference in the position of the seedlings as they appear above ground?
4. Of what advantage to the farmer is this tendency of seedlings to right themselves?

GROWTH

MATERIAL.—A flower pot suspended by a wire, some bulbs, and several well-developed seedlings to experiment with.

155. What Growth Is.—With the seedling begins the growth of the plant. Most people understand by this word, mere increase in size; but growth is something more than this. It involves a change of form, usually, but not necessarily, accompanied by increase in bulk. Mere mechanical change is not growth, as when we bend or stretch an organ by force, though if it can be kept in the altered position till such position becomes permanent, or as we say in common speech, "till it grows that way," the change may become growth. To constitute true growth, the change of form must be permanent, and brought about, or maintained by forces within the plant itself.

Remove the scales from a white-lily bulb, weigh them, and lay them in a warm, not too damp, place, away from light,

After a time young bulblets will form at the base of each scale. Weigh the scales again, and if there has been any loss, account for it (see Sections 24-27, and 65). The same experiment can be tried by allowing hyacinth or other bulbs to germinate without absorbing moisture enough to affect their weight.

156. Conditions of Growth.—The internal conditions depend upon the organization of the plant. The essential external conditions are: food material, water, oxygen, and a sufficient degree of warmth. It may be greatly influenced by other circumstances, such as light, gravitation, pressure, and (probably) electricity, but the four first named are the essential conditions without which no growth is possible.

157. Region of Growth.—It was seen in Sections 148 and 153 that the region of active growth in the root is just above the tip, behind the cap. In the stem the region of increase is more evenly distributed, the lower nodes continuing to grow for some time after the others are formed, but a little observation will show that in stems also, growth is usually most active in the region near the apex, where new cells are being produced.

158. Cycle of Growth.—When an organ becomes rigid and its form fixed, there is no further growth, but only nutrition and repair, processes which must not be confounded with it. Every plant and part of a plant has its period of beginning, maximum, decline, and cessation of growth. The cycle may extend over a few hours, as in some of the fungi, or, in the case of large trees, over thousands of years.

159. Direction of Growth.—Plant in a pot suspended as shown in Figure 252, a healthy seedling of some kind, two or three inches high, so that the plumule shall point downward through the drain hole and the root upward into the soil. Watch the action of the stem for six or eight days,

and sketch it. After the stem has directed itself well up-



252, 253. — Experiment showing the direction of growth in stems: 252, young potato planted in an inverted position; 253, the same after an interval of eight days.

ward, invert the pot again, and watch the growth. After a week remove the plant and notice the direction of the root. Sketch it entire, showing the changes of direction.

At the same time that this experiment is arranged, lay another pot with a rapidly growing plant on one side, and every forty-eight hours reverse the position of the pot, laying it on the opposite side. At the end of ten or twelve days remove the plant and

examine. How has the growth of root and stem been affected?

What do we learn from these experiments and from those in Sections 153 and 154, as to the normal direction of growth in these two organs respectively?

160. Geotropism. — This general tendency of the growing axes of plants to take an upward and downward course — in other words to point to and from the center of the earth — is called *geotropism*. It is positive when the growing organs point downwards, as most primary roots do; negative when they point upwards, as in most primary stems; and transverse or lateral, when they extend horizontally, as is the case with most secondary roots and branches.

161. Gravity and Growth. — It has been proved by experiment that geotropism is due to gravity. It must be carefully noted, however, that the influence here alluded to is not the mere mechanical effect of gravity due to weight of parts, as when the bough of a peach or an orange tree

is bent under the load of its fruit, but a certain stimulus to which the plant reacts by a spontaneous adjustment of its growing parts. In other words, geotropism is an active and not a passive function, and the plant will even overcome considerable resistance in response to it. If a sprouted bean is laid on a dish of mercury covered with a layer of water, as in Figure 254, the root will force its way downward into the liquid, although the mercury is fourteen times heavier than an equal bulk of the bean root substance, and the geotropism of the root must thus overcome a resistance equal to at least fourteen times its own weight.



254. — Experiment showing the root of a seedling forcing its way downward through mercury.

162. Other Factors. — The direction of growth is influenced by many other factors, such as light, heat, contact



255. — A piece of a haulm of millet that has been laid horizontally, righting itself through the combined influence of contact and negative geotropism.

with other bodies, and perhaps by electricity. The result of all these forces is an endless variety in the forms and

direction of organs that seems to defy all law. Heat, unless excessive, generally stimulates growth; contact sometimes simulates it, causing the stem to curve away from the disturbing object, and sometimes retards it, causing the stem to curve towards the object of contact by growing more rapidly on the opposite side, as in the stems of twining vines. Light stimulates nutrition, but generally retards growth. The heliotropic movements of plants (Sections 54-57) are effected in this way; the growth being checked on that side, the plant bends toward the light.

163. Internal Forces of the Plant. — Another important factor exists in the internal constitution of the plant itself. Place a segment of prickly pear (*Opuntia*) or other cactus, tip downward in the soil; roots will develop with great difficulty¹ because the natural forces of the plant tend to carry the root forming material to the base, and it takes time for the external factors of dampness, moisture, and gravitation to overcome this inherent tendency. Place two leafy twigs of some herbaceous plant, one in its natural position, the other bottom upwards, in a vase of water, and notice the difference in the wilting of the leaves, due to a physiological tendency in the conducting cells to carry the crude sap toward the apex.

PRACTICAL QUESTIONS

1. Why do stems of corn, wheat, rye, etc., straighten themselves after being prostrated by the wind? (162.)
2. Can a plant grow and lose weight at the same time? (155.)
3. Do plants grow most rapidly in the daytime, or at night? (162.)
4. Reconcile this with the fact that green plants will finally die if deprived of light.
5. Which would be richer in nourishment, hay cut in the evening or in the morning? Why? (24, 25, 26, 162.)
6. Which grows more rapidly, a young shoot or an old one?
7. Which, as a general thing, are the more rapid growers, annuals or perennials? Herbaceous or woody-stemmed plants?
8. Name some of the most rapid growers you know?
9. Of what advantage is this habit to them?

¹ Sachs, "Physiology of Plants."

FIELD WORK

The subjects treated in this chapter can best be studied in the laboratory, and afford little opportunity for field work, except in regard to the various adaptations for the protection and dispersal of seed. Look through the woods and fields for examples of these adaptations and explain how they are each suited to their purpose. To an imaginative mind there is something almost pathetic in what seem to be the shifts employed by the mother plants, themselves incapable of motion, to launch their offspring in the world.

Note the absence of weeds in woodlands and places remote from cultivation, and account for it. Look along railroads, along common roadsides, around wharves, factories, railroad stations, warehouses, and barnyards, for introduced plants, and account for their presence. Study the history, habits, and the local distribution of some of the common weeds of your neighborhood, and suggest means for extirpating them.

V. ROOTS AND UNDERGROUND STEMS

FUNCTION AND STRUCTURE OF ROOTS

MATERIAL. — Two earthen pots, with a growing plant in one. Some coarse netting, a common tumbler, and sprouting seeds of mustard, or other easily germinating kind. A stalk with roots, of corn or any kind of grass, and one of cotton or other woody plant. A woody taproot inserted in red ink from four to six hours before the lesson begins.

164. Roots as Holdfasts. — One use of ordinary roots is to serve as props and stays for anchoring plants to the soil. Tall herbs and shrubs, and vegetation generally that is



256. — Dandelion: *a*, common form, grown in plains region at low altitude; *b*, alpine form.

exposed to much stress of weather, are apt to have large, strong roots. Even plants of the same species will develop systems of very different strength according as they grow in sheltered or exposed places.

165. Root Pull. — Roots are not mere passive holdfasts, but exert an active downward pull upon the stem. Notice the rooting end of a strawberry or raspberry shoot and observe how the stem appears to be drawn into the ground

at the rooting point. In the leaf rosettes of herbs growing flat on the ground or in the crevices of walls and pavements, the strong depression observable at the center is due to root pull.

166. Roots absorb Moisture. — Fill two pots with damp earth, put a healthy plant in one and set them side by side in the shade. After a few days examine by digging into the soil with a fork and see in which pot it has dried most. Where has the moisture gone? how did it get out?



257. — Raspberry stolon showing root pull.

167. Roots shun the Light. — Cover the top of a glass of water with thin netting, lay on it sprouting mustard or other convenient seed. Allow the roots to pass through the netting into the water, noting the position of root and stem. Envelop the sides of the glass in heavy wrapping paper, admitting a little ray of light through a slit in one side, and after a few days again observe the relative position of the two organs. How is each affected by the light?

168. Roots seek Air. — Remove a plant from a porous earthenware pot in which it has been growing for some time; the roots will be found spread out in contact with the walls of the pot instead of embedded in the soil at the center. Why is this?

169. Roots seek Water. — Stretch some coarse netting covered with moist batting over the top of an empty tumbler. Lay upon it some seedlings, as in Section 167, allowing the roots to pass through the meshes of the netting. (A piece of cardboard with holes in it will answer.) Keep the batting moist, but take care not to let any of the water run into the vessel. Observe the position of the roots

at intervals, for twelve to twenty-four hours, then fill the glass with water to within 10 millimeters (a half inch, nearly) or less of the netting, let the batting dry, and after eight or ten hours again observe the position of the roots. What would you infer from this experiment as to the affinity of roots for water?



258.—Branched taproot of maple.

170. Taproots.—Gather a stalk of cotton or any hard wood shrub, and one of corn or other grain, and compare them with each other and with the roots of seedlings of the same species. Notice the difference in their mode of growth. In the first kind a single stout prolongation called a taproot proceeds from the lower end of the hypocotyl and continues the axis of growth straight downwards, unless turned aside by some external influence.

A taproot may be either simple, as in the turnip, radish, dandelion, and most herbs, or branched, as in shrubs and trees generally. In this case the main axis is called the primary root, and the branches are secondary ones.



260.—Fascicled and tuberous or fusiform (secondary) roots of dahlia: *a, a*, buds on base of the stem (*after GRAY*).

171. Fibrous and Fascicled Roots.—

In corn and other grasses the main axis has become aborted, or failed



259.—Fibrous root.

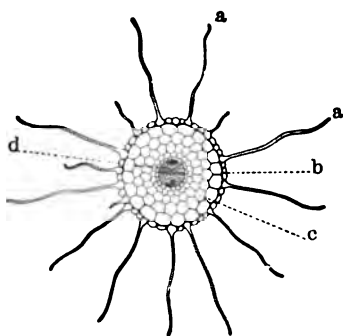
to develop, and a number of independent branches spring from its stub, forming what are known as fibrous roots: or the base of the hypocotyl, instead of continuing downward in a single axis, may split up into a number of smaller ones

as in the pumpkin. When roots of this kind are thick and fleshy, they are usually described as *fascicled*.

172. The Two Modes of Growth.—This difference in the mode of growth is very apparent in the seedling, as will be evident on referring to your sketches. The first kind is called the *axial* mode, because it is a continuation of the main axis of the plant; the second is the *nonaxial*, or for want of a better word we may call it the *radial* mode, since the roots radiate in all directions from a common axis.

173. Importance of this Distinction.—This distinction has important bearings in agriculture. Roots of the first kind, which are characteristic of most dicotyledons, strike deep, and draw their nourishment from the lower strata of the soil, while the radial kind spread out near the surface and are more dependent upon external conditions.

174. Root Structure.—Cut a cross section of any woody taproot about halfway between the tip and the ground level, examine it with a lens and sketch it. Label the dark outer covering, *epidermis*, the soft layer just within that, *cortex*, the hard, woody axis that you find in the center, *vascular cylinder*, and the fine silvery lines that radiate from the center to the cortex, *medullary rays* (in a very young root, these will not appear). Cut a section through a root that has stood in red ink for about three hours and note the parts colored by the fluid. What portion of the root, should you judge from this, acts as a conductor of the water absorbed from the ground?



261.—Cross section of a young taproot: *a, a*, root hairs; *b*, epidermis; *c*, cortical layer; *d*, fibrovascular cylinder. Note the absence of medullary rays during the first year of growth.

Make a longitudinal section through the upper half of

your specimen, continuing it an inch or two into the stem; do you find any sharp line of division between the two?

175. The Active Part of the Root.— It is only the newest and most delicate parts of the root that produce hairs and



262. — Root of a tree on the side of a gully acting as stem.

are engaged in the active work of absorption, the older parts acting mainly as carriers. Hence, old roots lose much of their characteristic structure and take on more and more of the office of the stem, until there is practically no difference between them. On the sides of gullies, where the earth has been

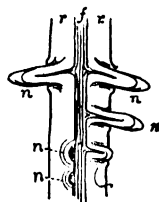
washed from around the trees, we often see the upper portion of the root covered with a thick bark and fulfilling every office of a true stem.

176. Use of the Epidermis.— Cut away the lower end of a taproot; seal the cut surface with wax so as to make it perfectly water-tight, and insert it in red ink for at least half the remaining length, taking care that there is no break in the epidermis. Cut an inch or two from the tip of the lower piece, or if material is abundant, from another root of the same kind, and insert it without sealing the cut surface, in red ink, beside the other. At the end of three or four hours, examine longitudinal sections of both pieces. Has the liquid been absorbed equally by both? If not, in which has it been absorbed most freely? What conclusion would you draw from this, as to the passage of liquids through the epidermis?

From this experiment we see that the epidermis, besides protecting the more delicate parts within from mechanical injury by hard substances contained in the soil, serves by

its comparative imperviousness to prevent evaporation, or reabsorption by the soil, of the sap as it flows from the root hairs up to the stem and leaves.

177. The Branching of Roots.—Peel off a portion of the cortex from any branching taproot and notice the hard, woody axis that runs through the interior. Pull off a branch from the stem and one from the root; which comes off most easily? Examine the points of attachment of the two and see why this is so. This mode of branching from the central axis instead of from the external layers, as in the stem, is one of the most marked distinctions between the structure of the two organs.



263. — Vertical section of branching root, showing the branches, *n, n*, originating in the central axis, *f*, and passing through the cortex, *r, r*.

178. Distinctions between Root and Stem.—In stems the branches always occur, as we saw in our study of leaves, at regular intervals called nodes (Sec. 50), while in the root they occur quite irregularly. The root grows only from just behind the tip; stems increase by the development of successive internodes, each of which may continue to grow for some time after the development of its successor (Secs. 153, 157). The stem is normally an ascending, the root a descending, axis; the one bears leaves and buds at regular intervals, the other bears no leaves and only occasional buds of the kind called *adventitious*; that is, buds which appear by chance, as it were, at irregular intervals. There are other distinctions recognized by botanists, but they are too technical to be considered here.

PRACTICAL QUESTIONS

1. Why will most plants grow so much better in an earthen pot or a wooden box than in a vessel of glass or tin? (168.)
2. Which absorb most from the soil, plants with light roots and abundant foliage or those with heavy roots and scant foliage?
3. Which will require the deeper tillage, a bed of carrots or one of strawberries? (173.)

4. Which will best withstand drought, a crop of cotton or one of Indian corn? Which will thrive best on high and dry ground? (173.)

5. Which will interfere least with the nourishment of the trees if planted in a peach orchard, cotton or oats? (173.)

6. Should a crop of cotton and one of hemp succeed each other on the same land?

7. Why does the gardener manure a grass plat by scattering the fertilizer on top of the ground while he digs around the roses and lilacs and deposits it underground?

8. Where should the manure be placed to benefit a tree or shrub with wide-spreading roots? (175.)

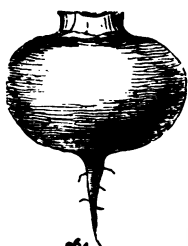
9. Is it a wise practice to mulch a tree by raking up the dead leaves and piling them around the base of the trunk, as is so often done? Why, or why not?

10. Why are willows usually selected in preference to other trees for planting along the borders of streams in order to protect the banks from washing?

FLESHY ROOTS

MATERIAL. — A turnip, or other fleshy root. Another root of the same kind that has stood in red ink for several hours.

179. Structure of Fleshy Roots. — Cut away an inch or two from the tip of a young fleshy root of any kind, and let it stand from six to twelve hours in red ink. Then cut into two or three equal transverse sections and observe the course of the fluid. Through what portion did it rise most readily? Sketch one of the sections and compare it with your drawing of the woody tap-



264-266. — Shapes of fleshy roots (GRAY): 264, napiform; 265, conical; 266, spindle-shaped.

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abled to keep their underground parts alive through the supply of nourishment stored in their roots, and thus get the advantage of their competitors by starting out in spring with a good supply of food on hand. If you will dig around any of our hardy winter herbs, such as the rib grass (plantain), dandelion, and common dock, that keep a rosette of green leaves above ground all the year, you will generally find that they have a more or less fleshy tap-root full of nourishment, stored away underground.

PRACTICAL QUESTIONS

1. Compare a root of wild carrot with a cultivated one; what difference do you see?
2. Why are the fleshy roots of wild plants so much smaller than those of similar species in cultivation?
3. Why do farmers speak of turnips and other root crops as "heavy feeders"? (180.)
4. Which is most exhausting to the soil, a crop of beets, or one of oats? Onions, or green peas?
5. Which is best to succeed a crop of turnips on the same land, hay or carrots?
6. Write out what you think would be a good rotation for four or five successive crops.
7. Study the following rotations and give your opinion about them; suggest any improvements that may occur to you, and give a reason for the change: Beets, barley, clover, wheat; cotton, oats, peas, corn; oats, melons, turnips; cotton, oats, corn and peas mixed, melons; cotton, hay, corn, peas.

SUB-AËRIAL ROOTS

MATERIAL. — A hyacinth bulb or a cutting of wandering Jew grown in a glass of water. Specimens of any kind of parasitic plants that can be obtained, such as mistletoe, dodder, resurrection fern (*Polypodium incanum*), etc. Freshly rooted cuttings of geranium, coleus, or other easily rooting twig.

182. Subterranean and Sub-aërial Roots. — The roots we have been considering are all subterranean and bring the plant into relation with the earth, whether for purposes of nourishment, or of anchorage to a fixed support, or, as in the majority of cases, for both. But many plants do not get their nourishment directly from the soil, and these give

rise to the various forms of sub-aërial roots, or those that grow above ground.

183. Water Roots. — Large numbers of plants are adapted to live in the water, either floating freely, as the duckweed (*Lemna*) and bladderwort (*Utricularia*), or anchored to mud and sticks on the bottom. Water roots are generally white and threadlike and more tender and succulent than ordinary soil roots. Many land plants will develop water roots and thrive on that element if brought into contact with it. Place a cutting of wandering Jew in a clear glass of water, and in from four to six days it will develop beautiful water roots in which both hairs and cap are clearly visible to the naked eye.

The chief office of ordinary roots being to absorb moisture, they have a great affinity for water, and its presence or absence exerts a strong determining influence on their direction, often overcoming that of geotropism (Sec. 169).

184. Parasitic Plants are those that live by attaching themselves to some other living organism, from which they draw their nourishment ready made. Their roots are adapted to penetrating the substance of the *host*, as their



267



268

267, 268. — Mistletoe penetrating bough of oak: 267, lower part of stem attached to branch; 268, longitudinal section through one of the haustoria strands, showing its progress as the branch thickens.

victim is called, and absorbing the sap from it. They are appropriately named *haustoria*, a word meaning suckers, or absorbers. Dodder and mistletoe are the best-known examples of plant parasites, though the latter is only partially parasitic, as it merely takes up the crude sap from the host and manufactures it into food by means of its own green leaves.

185. Saprophytes are plants like the Indian pipes (*Monotropa*) and squaw root (*Conopholis*) that live upon dead and decaying vegetable matter. They are only partially par-



269. — Roots of *Gerardia parasitica* underground (after GRAY).

asitic, and do not bear the haustoria of true parasites. A good many plants that appear to live an honest life above ground practice a secret parasitism by sending their roots into

those of their neighbors beneath the soil and drawing part of their nourishment from them. Among those that show a propensity to this degenerate habit are the pretty yellow gerardias, and their kindred, the yellow rattle (*Rhinanthus*), and the Canada lousewort (*Pedicularis*).

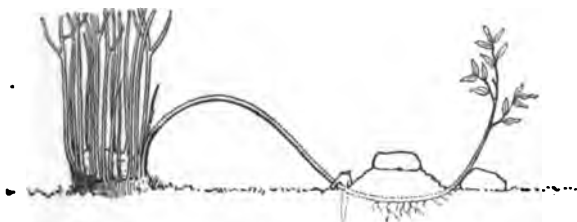
186. Aërial Roots are such as have no connection at all with the soil or with any host plant, except as they may lodge upon the trunks and branches of trees for a support. In our climate aërial roots are generally subsidiary to soil roots, like the long dangling cords that hang from some species of old grape vines; or they subserve other purposes altogether than absorbing nourishment, as the climbing roots of the trumpet vine and poison ivy.



270. — A small orchid with aërial roots, growing on the bough of a tree (after GRAY).

187. Adventitious Roots is a name applied to any kind that occur on the stems of plants or in other unusual positions. Common examples are the roots that put out from the lower nodes of corn and sugar cane and serve both to supply additional moisture and to anchor the plant more firmly to the soil. Most plants will develop adventitious roots if covered with earth or even if merely kept in contact with the ground. The gardener takes advantage of this property when he propagates by cuttings or layers.

Place a cutting of rose geranium or of coleus in a pot of moist sand. As soon as the roots begin to form, examine the stem with a lens to see from what portion they spring



271. — New stocks with adventitious roots produced by layering.

— whether from near the circumference, or from the center. What part of the stem should you infer from this, is most actively concerned in the work of growth?

PRACTICAL QUESTIONS

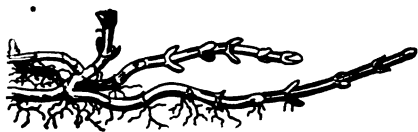
1. Do the adventitious roots of such climbers as ivy and trumpet vine draw any nourishment from the objects to which they cling?
2. How do you know this?
3. Do they injure trees by climbing upon them; and if so, how?
4. What is the use of the aërial roots of the scuppernong grape?
5. Is the resurrection fern (*Polypodium incanum*) a parasite or an air plant?
6. On what plants in your neighborhood does mistletoe grow most abundantly? Dodder?
7. Is mistletoe injurious to the host?
8. Name some plants that are propagated mainly, or solely, by roots and cuttings.

UNDERGROUND STEMS

MATERIAL. — Underground stems of couch grass, nut grass, violet, iris, or any rootstocks obtainable. In cities, if nothing better is to be had, some dried orris root or calamus might be obtained from a druggist. Any kind of tuber, such as potato, artichoke, Madeira vine, etc. A sweet potato. A scaly lily bulb and one of onion or hyacinth. Potatoes and sweet potatoes treated with red ink.

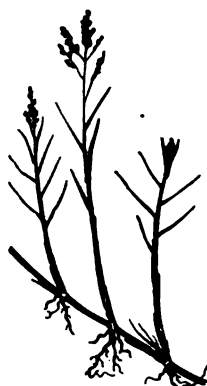
188. Rootstocks. — So like fleshy roots are certain thickened underground stems that it is not always easy to distinguish between them. So long as the stem remains above

ground there is little danger of mistaking its identity, even when it puts forth roots from every node, like the creeping stems of Bermuda grass and couch grass. Even in such underground stems as those of the mint and couch grass their real nature is evident from



272. — Running rootstock of peppermint (GRAY).

the regular nodes into which they are divided, and the scales which they bear instead of leaves. Stems of this kind are called rootstocks. They usually send out roots from every node and are the most ineradicable pests the farmer has to contend with, since each joint is capable of developing into a new plant, and chopping them to pieces serves only to aid in their propagation.



273. — Rootstock of creeping panic grass.

189. Rhizomas. — Rootstocks do not always retain their stemlike nature so plainly, but are commonly more or less shortened and thickened, as in the violet, iris, bulrush, sweet flag, bloodroot, etc., and it is to this condition that the name rhizoma is usually applied. A typical example of



274. — Rhizoma of Solomon's seal (after GRAY).

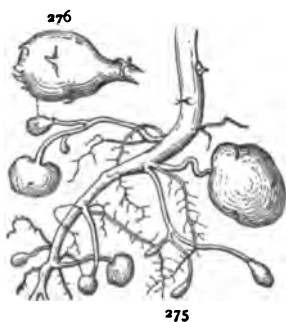
the rhizoma is that of the Solomon's seal (Fig. 274.) The peculiar scars from which it takes its name are caused by the falling away each year of the flowering stem of the season, after its work is done, leaving behind the joint or node of the underground stem from which it originated. Thus the plant lives on indefinitely, growing and increasing at one end as fast as it dies at the other. The joints on the rhizoma mark, not the age of the plant, but of each joint or internode. If there are two or three joints, this indicates

that the oldest of them is two or three years old, as the case may be.

Examine a rhizoma of the iris, or any other specimen obtainable. How many joints do you find? Where is the oldest? How old is it? Are they all entirely underground? Where do the true roots spring from? The flower stems? Notice the rings or ridges that run across the upper side of each joint. These are the leaf scars, and each scar marks one of the very short internodes of the past season's growth. At the nodes, in the axils of the leaf scars, buds frequently occur, producing other joints, which may be considered branches, and it is these branches that give to the rootstocks of the iris and blackberry lily their thick, matted appearance. How many leaves did last year's joint of your specimen bear, and how many internodes had it?

190. Tubers. — When a rhizoma is very greatly enlarged, as in the artichoke and potato, it is called a *tuber*. Its real nature in such cases is often very much disguised, but a little study will make it clear. The so-called root of wild smilax shows very plainly the gradations from leaves to scales and from stem to tuber.

In the typical tuber, of which the potato is the most familiar example, the internodes are so thickened and shortened as to have lost all resemblance to a stem, but their nature is revealed by the *eyes*. These are really nothing else than buds growing in the axils of leaves, which are represented in the potato by the little scale that forms the lid to the eye. (In an old potato the scales will probably have disappeared; try to get fresh ones for examination, and if possible, with some of the attaching stems still remaining. The artichoke and



275, 276. — Tubers (after GRAY): 275, forming potatoes; 276, young potato enlarged.

tubers of the Madeira vine also make good objects for study.) Notice the arrangement of the eyes, or buds; is it alternate or opposite? How many ranked? Make a sketch of the potato as it appears on the outside. Make a similar sketch of the sweet potato, and compare the two. Is there any scale below the eye in the sweet potato? Do the eyes occur in any regular order?

191. Make a cross section of each, and sketch them. Notice the thin dark ring that runs around the inside of the potato at some distance from the circumference. Label this *vascular tissue*; the loose porous layer between it and the skin, *cortex*; the central portion within the vascular ring, *pith*; and the outer skin, *epidermis*. See if you can find corresponding parts in the sweet potato, and label them.

Put one of the cut ends of each in red ink (this should have been attended to before the recitation), let them stand four to five hours, then make sections parallel to the cut surface till you reach the point where the red ink has penetrated; what difference do you notice? Which has the thicker cortex? Compare the behavior of the potato with that of the turnip treated with red ink in Section 179. What would you infer from this as to the office of the woody tissue? What is the office of the epidermis? If you are in doubt, peel a tuber and weigh it. At the same time weigh one of about the same size from which the skin has not been removed, and put the two side by side in a dry place. At the end of three or four days weigh them again and see which has lost the most.

We have learned that roots are not divided into nodes, that they never bear leaves, that they branch quite irregularly, and that they sometimes bear adventitious buds. Now can you state some of the reasons why the potato is regarded as a stem and the sweet potato as a root?

192. Storage of Nourishment. — The object of both is the same, the storage of nourishment. Drop a little iodine on each and see what this nourishment consists of. Which contains the more starch?

It is this abundant store of food that makes the potato such a valuable crop in cold countries like Norway and Iceland, where the seasons are too short to admit of the slow process of developing the plant from the seed.

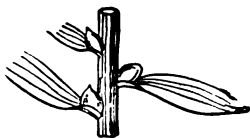
193. The Bulb is a form of underground stem reduced to a single bud. Get the scaly bulb of a white garden lily, and sketch it from the outside and in cross and vertical section. Compare it with the scaly winter buds of the oak and hickory or other common deciduous tree. Make an enlarged sketch of the latter on the same scale as the lily, and the resemblance will at once become clear. The scales of the bulb are, in fact, only thick, fleshy leaves



277. — Scaly bud of oak enlarged.



278. — Scaly bulb of lily (GRAY).



279. — Bulblets in the axils of the leaves of a tiger lily (GRAY).

closely packed round a short axis that has become dilated into a flat disk. From the terminal node of this transformed stem, *i.e.*, the center of the disk, rises the flower stalk, or *scape*, as it is called, of the season. After blossoming, the scape perishes with its bulb, and their place is taken by new ones which are developed from the axils of the scales, thus revealing their leaflike nature.

That bulbs are only modified buds is further shown by the bulblets that sometimes appear among the flowers of the onion, and in the leaf axils of certain lilies. They never develop into branches, but drop off and grow into new plants just as the subterranean bulbs do.

194. Tunicated Bulbs. — Compare an onion or a hyacinth bulb with a lily bulb. In what respect does it differ from the lily bulb? Pull off the outer layers, which have

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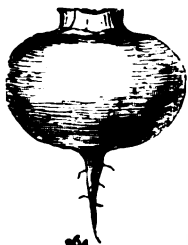
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10. Why are willows usually selected in preference to other trees for planting along the borders of streams in order to protect the banks from washing?

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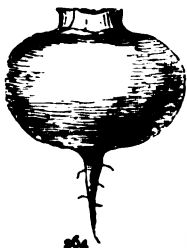
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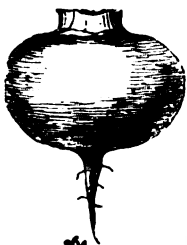
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6. Should a crop of cotton and one of hemp succeed each other on the same land?
7. Why does the gardener manure a grass plat by scattering the fertilizer on top of the ground while he digs around the roses and lilacs and deposits it underground?
8. Where should the manure be placed to benefit a tree or shrub with wide-spreading roots? (175.)
9. Is it a wise practice to mulch a tree by raking up the dead leaves and piling them around the base of the trunk, as is so often done? Why, or why not?
10. Why are willows usually selected in preference to other trees for planting along the borders of streams in order to protect the banks from washing?

FLESHY ROOTS

MATERIAL.—A turnip, or other fleshy root. Another root of the same kind that has stood in red ink for several hours.

179. Structure of Fleshy Roots.—Cut away an inch or two from the tip of a young fleshy root of any kind, and let it stand from six to twelve hours in red ink. Then cut into two or three equal transverse sections and observe the course of the fluid. Through what portion did it rise most readily? Sketch one of the sections and compare it with your drawing of the woody tap-



264-266. — Shapes of fleshy roots (GRAY): 264, napiform; 265, conical; 266, spindle-shaped.

root. The ring of ink marks the boundary between the cortex and the central axis. Cut through one of the sections vertically and notice that the portion marked "vascular cylinder" in the hard root has here been replaced by a soft, nutritious substance. Put a drop of iodine on it and see if it contains starch. Peel off a part of the cortex and observe that the woody or conducting portion of the interior is confined principally to a thin layer on the outside of the thickened fleshy axis. Can you tell now why the course of the red ink in this kind of root is confined mainly to a ring just inside the cortex, while in hard roots—in the newer, active parts of them at least—it runs through the whole of the central axis? (Sec. 174.)

This band of woody or vascular tissue, as it is called, becomes very evident in old turnips and radishes. In the beet it is arranged peculiarly, being disposed in concentric layers alternating with the fleshy substance, instead of in a single layer next the cortex. These vascular rings give to a section of beet the appearance of certain woody stems with their rings of annual growth, but their origin is quite different.

180. Function of Fleshy Roots.—What is the use of fleshy roots? We give a practical answer to this question every time we eat a carrot or a turnip. Fleshy roots are especially useful to *biennials*, a name given to herbs that take two years to perfect their fruit, in contradistinction to *annuals*, which complete their life history in a single season. The biennials spend their first year in laying by a store of nourishment which they use up the next year in producing a crop of seed—provided man does not forestall them and appropriate it to his own use. This explains why a radish or a turnip is so dry and tasteless the second year; nearly all of its store of food has been exhausted in maturing seed.

181. Perennial Herbs are those that live on indefinitely from year to year. Many of these, like the dahlia and hawkweed, die down above ground in winter but are en-

208. Runners and Stolons, of which we have familiar examples in the strawberry and currant respectively, are stems or branches by which plants propagate themselves above ground as readily as by rootstocks underground. Suckers are shoots from adventitious root buds. The rose, raspberry, blackberry, and asparagus are propagated almost entirely by their means. The little shoots, called by gardeners scions, that spring up around the foot of apple and pear trees, and many others, have a similar origin.



289. — Orange hawkweed with runners.

209. Modifications of the Stem. —

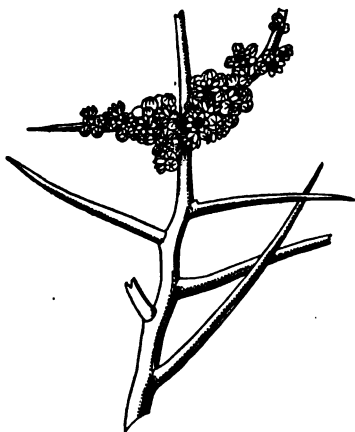
Like leaves, the stem is subject to many modifications, and is made to serve various purposes other than its normal ones. With some of these we have already become acquainted in its underground condition. Aërial stems frequently serve like purposes. The sugar cane carries a rich supply of sweets in its juicy internodes, and cabbage stalks also are well stocked with food before flowering. In the cactus family, which inhabit dry and desert regions, where the scanty moisture they draw from the earth would be too rapidly exhaled from the expanded surface of leaves, the foliage has either disappeared altogether or been reduced to mere spines, while the greatly thickened stems have taken upon themselves the triple office of leaf, stalk, and store-room. Examine a potted cactus, or a joint of the common prickly pear, and notice how the whole plant has been compacted into a form that exposes



290. — Melon cactus, showing greatly condensed stem for the storage and preservation of moisture.

the least possible extent of surface in proportion to the substance contained in it.

210. Weapons of Defense.— Examples of these may be seen in the thorns of the honey locust, the hawthorn, and old field plums. An examination of the haw, crab tree, plum, and pear will show stems in all stages of transformation from short, stubby branches to well-defined thorns. This kind of thorn must not be confounded with briars or prickles like those of the rose and smilax, which are mere appendages of the epidermis, while thorn branches have their origin in the wood beneath. They usually come from adventitious buds.



291.— Thorn branches of *Holocantha Emoryi*, a plant growing in arid regions.

211. Stems as Tendrils.— Stems are also frequently met with under the form of tendrils. As normal buds and branches never grow except from the axils of leaves, this kind of tendril can always be recognized by its position. In the grape and Virginia creeper, where they appear opposite the leaves on alternate sides of the stem, they represent terminal



292.— Stems of a passion flower transformed into tendrils (after GRAY).

flower buds which have been pushed aside by stronger

lateral ones (Sec. 245).¹ The usurping bud continues the growth of the shoot until it is in turn displaced by some succeeding lateral one, and so on, forming a succession of apparently lateral tendrils.

212. Stems as Foliage.—When branches take the place of foliage, as they not infrequently do, they are generally



293.—Stem leaves (cladophylls) of a *ruscus*, bearing flowers.

so much disguised that it is difficult to recognize them, but a little attention to their point of origin will usually make their nature clear. The asparagus has already been referred to (Sec. 68). Still more striking examples are found in the butcher's broom of Europe (*Ruscus aculeatus*) and the pretty little *Myrsiphyllum* of the greenhouses, wrongly called smilax, that is so much used for decoration. The green blades of these plants, which are

commonly regarded as foliage, are not true leaves, but curiously shortened and flattened branches that have taken upon themselves the office of leaves. Their real nature is shown by the fact that they spring each from the axil of a little scale or bract that represents the true leaf.

PRACTICAL QUESTIONS

1. Which of the stems named below are woody, and which herbaceous, or suffrutescent? Blackberry, hollyhock, pokeweed, cotton, okra, morning-glory, asparagus, garden sage, reed, corn, wheat, periwinkle, sunflower, strawberry, bear's grass, broom straw.

2. Why is it that so many, both of hot-weather and cold-weather herbs, for example, knotweed (*Polygonum aviculare*), purslane, spurge, carpet weed (*Mollugo*), winter chickweed, Indian strawberry, and dandelion, all adopt the same habit of clinging close to the earth? (205.)

3. Would such a habit be of any advantage to roadside weeds and other herbs growing in exposed places where they are liable to be trodden upon and bitten by cattle?

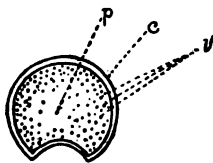
¹ See also Gray's "Structural Botany," page 54, § 110.

4. Is there any difference in the height of the stem of a dandelion flower and a dandelion ball?
5. Of what advantage is this to the plant?
6. By what means does the gourd climb? the butter bean? the English pea? trumpet honeysuckle? grape? maypop? smilax? Virginia creeper? clematis?
7. Why do we "stick" peas with brush, and hops with poles?
8. Are gourds, watermelons, squashes, pumpkins, etc., naturally climbing, or prostrate?
9. Why does not the gardener provide them with poles or trellises to climb on?
10. Name some plants the stems of which are used as food.
11. Name some stems from which useful articles, such as sugar, gums, and medicines are obtained.
12. Do twining plants grow equally well on horizontal and upright supports? (159, 160, 244)
13. If there is any difference, which do they seem to prefer?

STEMS OF MONOCOTYLEDONS

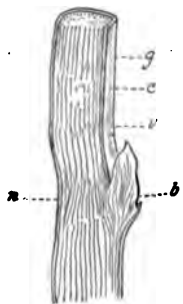
MATERIAL. — A stem of smilax, asparagus, or other monocotyledon that has stood in red ink for three to six hours. A dried cornstalk; the handle of a palm-leaf fan. (It would be better, of course, to have all specimens fresh, if possible, and for those who live in the southern States fresh stalks of sugar cane, palmetto, or yucca, will afford admirable objects for study.)

213. Examination of a Monocotyledonous Stem. — Take one of the dry cornstalks that can be found in the fields, almost anywhere, and study its external characters. How are the internodes divided from one another? What is the use of the very firm, smooth epidermis? Notice a hollow, grooved channel running down one side of the joints, or internodes; does it occur in all of them? Is it on the same side or on opposite sides of the alternate internodes? Follow one of these grooves to the node from which it originates; what do you find there? (In a dried stalk the bud will probably have disappeared, but traces of it can usually be found.) After studying the internal



294. — Cross section of a stalk of corn: *v*, fibrovascular bundles; *c*, cortex; *p*, pith.

structure of the stalk you will understand why this groove should occur on the side of an internode bearing a bud or fruit.

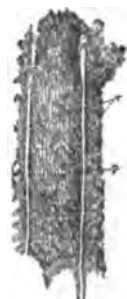


295. — Vertical section of cornstalk: *g*, groove; *c*, cortex; *v*, fibrovascular bundles mingled with parenchyma; *b*, bud; *n*, node.

Cut a cross section midway between two nodes, and observe the composition of the interior; of what does the bulk of it appear to consist? Notice the arrangement of the little dots like the ends of cut-off threads that are scattered through the pith; where do they appear to be most abundant, toward the center or the circumference?

Make a vertical section through one of the nodes. Cut a thin slice of the pith, hold it up to the light, and examine it with a hand lens. Observe that it is composed of a number of tiny oblong compartments or cells packed together like bricks in a wall. These are dry and empty now, but in the living stem were filled with nourishing fluids consisting of *protoplasm* and cell sap (Sec. 9), and formed what is known to botanists as the *parenchyma*, a word meaning parent tissue, because from it all the other tissues are derived.

Draw out one of the woody threads running through the pith. Break away a bit of the epidermis and see how very closely they are packed on its inner surface. Trace the course of the veins in the bases of the leaves that may be found clinging to some of the nodes; find their point of union with the stem; with what part of it do they appear to be continuous? Has this anything to do with the greater abundance of fibers near the epidermis? Can you follow the fibers through the nodes, or do they become confused and intermixed with other threads



296. — Vertical section of a portion of the interior of a dry cornstalk as seen under the lens, showing the cellular structure of the parenchyma: *v*, fibrovascular bundles; *p*, pith, or parenchyma.

there? (If sugar cane is used for this study, the ring of scars left by the vascular bundles as they pass from the leaves into the stem will be seen beautifully marked just above the nodes.)

If there is an eye or bud at the node, look and see if any of the threads go into it. Can you account now for the depression that occurs in the internode above the eye or bud?

Make drawings of both cross and vertical sections showing the points brought out in your examination of the corn-stalk.

214. The Vascular System.—To find out the use of the threads that you have been tracing, examine a piece of a living stem of wild smilax or other monocotyledon that has stood in red ink for three to twenty-four hours. (If the specimen stands in the coloring fluid too long the dye will gradually percolate through all parts of it. If this should be the case, look for the lines that show the ink most plainly.) Notice the course the coloring fluid has taken; what would you infer from this as to the office of the woody fibers?

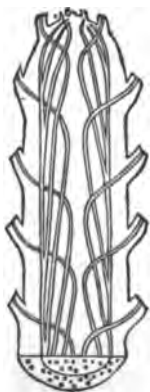
These threads constitute what is called the *vascular system* of the stem, because they are made up, to a large extent, of little *vessels* or *ducts*, along which the sap is conveyed from the roots to the leaves and back from the leaves to the root and stem after it has been elaborated into food. They are, so to speak, the water pipes that supply the leaf community with the liquid nourishment which it works up into food during the process of photosynthesis (Sec. 24).

215. The Stem as a Water Carrier.—We see from this, that the stem, besides serving as a mechanical support, is the natural line of communication between the roots, where the raw material for feeding the plant is gathered, and the leaves, where this material is manufactured into food. After the sap is there elaborated and the surplus moisture given off by transpiration, the nourishment is

returned to be distributed to the other organs. Even the roots can not be fed by the liquid they absorb from the soil until it has been elaborated in the leaves, just as our bodies can not be sustained by what we eat and drink until it has been digested in our stomachs. Hence, if the leaves of a tree are diseased or destroyed by ignorant pruning, the roots will suffer and die just as the leaves do if the roots are injured.

On account of this double line of communication which they have to maintain, the vascular threads, or *bundles*, as they are technically called, are double; one set, composed of larger ducts, carrying water up, and another set of smaller ones bringing back the digested food. Can you give a reason for their difference in size?

216. Woody Monocotyledons. — Examine sections of yucca, smilax, or of palmetto from the handle of a fan, and compare them with your sketches of the cornstalk. In which are the vascular fibers most abundant? Which is the toughest and strongest? Why? Trace the course of the leaf fibers from the point of insertion to the interior. How does it differ from that of the fibers in a cornstalk?



297. — Longitudinal section through the stem of a palm, showing the curved course of the fibrovascular bundles (GRAY, after FALKENBERG).

217. Growth of Monocotyledonous Stems. — Refer to the experiment in Section 43; refer also to what has just been learned regarding the course of the leaf veins at the nodes of the cornstalk (Sec. 213), and you will have no difficulty in identifying these veins as part of the vascular system. Each successive leaf sends its vascular bundles down into the main system of the stem, and any increase in the diameter of monocotyledons takes place by the intercalation of new bundles from the leaves as they develop at the nodes above. In jointed stems like the corn and sugar cane and other grasses,

this intercalation takes place, as we have seen (Sec. 213), at the nodes, forming the hard rings known as joints, but in other monocotyledons the fibers entering the stem from the leaves generally tend first downwards, towards the interior (Fig. 297), then bend outward toward the surface, where they become entwined with others and form the tough, inseparable cortex that gives to palmetto and bamboo stems their great strength.

This addition of fresh vascular bundles as the axis lengthens will explain why the lower joints of cornstalks and sugar cane are so much more hard and woody than the upper ones. Generally, however, monocotyledonous stems do not increase in diameter after a certain point, and as they can contain only a limited number of vascular fibers, they are incapable of supporting an extended system of leaves and branches. Hence this class of plants, with a few exceptions, like smilax and asparagus, are characterized by simple, columnar stems, and a limited spread of leaves. The cabbage palmetto, banana, and Spanish bayonet (*Yucca aloifolia*) are familiar examples in the warmer parts of our country.



298. — A palm tree, showing the tall, branchless trunk of monocotyledons.

218. Strength of the Monocotyledonous Structure.—Stems of this class are admirably adapted by their structure to the purposes of mechanical support. It is a well-known law of mechanics that a hollow cylinder is a great deal stronger than the same mass would be in solid form, as may easily be tested by the simple experiment of breaking in your fingers a cedar pencil and a joint of cane or a stem of smilax of the same weight. In stems that may be technically classed as solid in structure, like the corn and palmetto, the interior is so light compared with the hard epidermis that the result is practically a hollow cylinder.

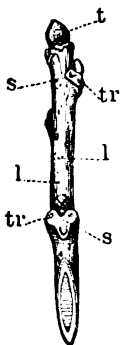
PRACTICAL QUESTIONS

1. Old Fort Moultrie near Charleston was built originally of palmetto logs; was this good engineering or not? Why?
2. Why is a stalk of sugar cane so much heavier than one of corn? A green cornstalk than a dead one? (215.)
3. Explain the advantages of structure in a culm of wheat; a stalk of corn; a reed. (218.)
4. Would the same quality be of advantage to an oak? Why, or why not?
5. Is it any advantage to the farmer that grain straw is so light?

STEMS OF DICOTYLEDONS

MATERIAL. — Twigs from one to three years old of almost any kind of hard wood shoots; elm, basswood, mulberry, leatherwood, and paw-paw show the bast well; sassafras, slippery elm, birthwort (*Aristolochia*), and in spring, hickory and willow, show the cambium; grape and Trumpet vine the ducts. Have some twigs placed in red ink from four to twelve hours before the lesson begins. Grape, peach, or hickory will answer well for this purpose.

219. Examination of a Typical Specimen. — Examine carefully the outer surface of a young twig, not less than one nor more than three years old, of any convenient specimen. Notice the scars left by the leaves of the season as they fell away, and look for one or more little roundish dots called *leaf traces*, that mark the points where the fibrovascular bundles from the leaf veins passed into the stem. The little oblong or lens shaped corky spots that dot the surface of a twig are called *lenticels*. They are the breathing pores or ventilators through which the air penetrates to the inner parts of the stem. They usually disappear on older branches, where the outer bark is constantly breaking away and sloughing off. Sometimes, however, they are quite persistent, as in the peach, cherry, and china tree. The characteristic markings of the birch bark, which make it so ornamental, are due to the lenti-



299. — Alternate leaved twig of walnut: *t*, terminal bud; *s, s*, leaf scars; *tr*, leaf traces; *ll*, lenticels.

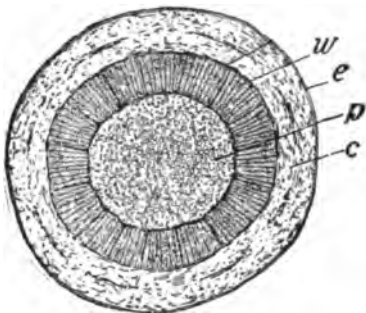
cels. As the tree grows they elongate either vertically, by the lengthening of the twig, or horizontally, by its increase in diameter, until they often appear as long slits.

Scrape off a little of the brownish, or sometimes almost colorless outer covering. This is the epidermis, and is replaced by the outer corky layer of the bark in older stems. As the stem increases in diameter from year to year this outer covering is broken up and pushed aside to make way for the new growth, so that the bark is constantly dying and sloughing off from the outside and as constantly renewed from within. Under the epidermis, notice a greenish layer of young bark; beneath this a layer of rather tough, stringy fibers called *bast*, and finally a harder woody substance that constitutes the bulk of the interior of the stem. Cut through this to the very center of the axis and we find a cylinder of lighter, pithy texture; this is the same as the parenchyma or parent tissue that we found pervading the interior of the cornstalk (Sec. 213). It is usually called the pith or *medulla*, and is the only part present in very young stems.

Between the woody axis and the bark is a more or less soft and juicy ring called

220. The Cambium Layer.—This is not always easily distinguishable with a hand lens, but is conspicuous in the stems of sassafras, slippery elm, aristolochia, etc. If some of these can not be obtained, the presence of the cambium can be recognized by observing the tendency of most stems to “bleed” when cut, between the wood and bark. This is because the cambium is the active part of the stem in which growth is taking place, and consequently it is most abundantly supplied with sap. This is especially the case in spring, when it becomes so gorged with nourishment that if a rod of hickory or elder is pounded, the pulpy cambium is broken up and the bark may be slipped off whole from the wood. It is the nourishment contained in the cambium of certain plants that tempts goats and calves to bark them in spring, and that enables savages, in time

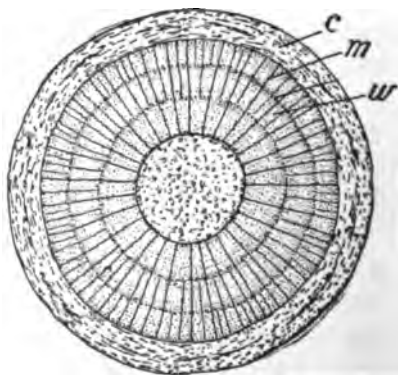
of dearth, to subsist for a while on the buds and bark of trees.



300.—Section across a young twig of box elder, showing the four stem regions: *e*, epidermis, represented by the heavy bounding line; *c*, cortex; *w*, vascular cylinder; *p*, pith. (From COULTER'S "Plant Relations.")

the woody part in the cross section; where are they largest and most abundant? How are the rings marked off from one another? These pores are sections of the ducts already alluded to (Secs. 214, 215). They are very large in the grape vine, and a cutting two or three years old will show them distinctly. Examine cross and vertical sections of a twig that has stood in red ink from three to twelve hours and observe the course the fluid has taken. (The rapidity with which the liquid is absorbed varies with different stems and at different seasons. It is most rapid in spring and slower in winter. In grape, plum, and peach it ascends quickly.) What should you

221. Difference between Dicotyledons and Monocotyledons.—Cut cross and vertical sections of your specimen, and sketch them as seen under the lens, labeling the different parts that have been examined. Refer to Figures 300 and 301 if you have any difficulty in distinguishing the parts. Notice the little pores or cavities that dot



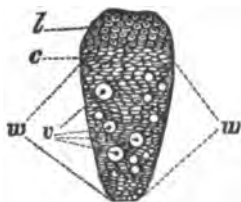
301.—Section across a twig of box elder three years old, showing three annual growth rings, in the vascular cylinder. The radiating lines (*m*), which cross the vascular region (*w*), represent the pith rays, the principal ones extending from the pith to the cortex (*c*). (From COULTER'S "Plant Relations.")

infer from this as to the office of the ducts? How does this conclusion compare with your observations on the vascular bundles of monocotyledonous stems? Notice that the dicotyledon differs from monocotyledonous stems in having the pith all gathered in a narrow cylinder in the center, and the vascular tissue arranged in one or more concentric layers around it, according to the age of the stem. In general, dicotyl stems may be said to include four regions; 1st, the epidermis or bark, *e* (Fig. 300); 2d, the cortex, *c*, made up of the cambium and bast, with certain other tissues; 3d, the vascular cylinder, or woody portion *w*, made up of concentric rings each representing a year's growth; and 4th, the pith *p*, medulla, or parenchyma, as it is variously termed by botanists.

222. Medullary Rays.—Observe the whitish silvery lines that radiate in every direction from the center, like the spokes of a wheel from the hub. These are the medullary rays and consist of threads of pith that serve as lines of communication between the “parent tissue” and the growing cambium layer. In old stems the central pith frequently disappears and its office is filled by the medullary rays, which become quite conspicuous.

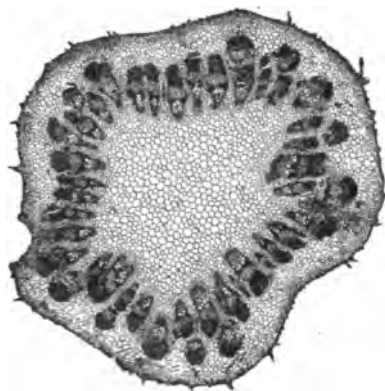
223. The Rings, into which the vascular cylinder is divided, mark the yearly additions to the growth of the stem, which increases by the constant addition of fibro-vascular bundles from the outside; hence such stems are called *exogens* or “outside growers.”

224. The Structure of the Fibro-vascular Bundles is somewhat complicated and can not be studied to advantage without the aid of a compound microscope, but a little attention to the diagrams will make it intelligible. The inner part of each bundle (*i.e.*, the part toward the axis) is made up of woody fibers shown at



302. — Transverse section of vascular bundle from stem of a dicotyledon: *l*, bast; *c*, cambium; *v*, ducts, *w*, wood cells.

w (Fig. 302), intermingled with larger sized tubes or ducts, *v*, the sections of which made the pores referred to in Section 221. In front of these is the cambium layer, *c*, and



303.—Transverse section of a stem of burdock, showing fibrovascular bundles not completely united into a ring.

beyond that, the soft bast and other tissues in which elaborated food is being brought down from the leaves and material for growth provided. In very young stems the vascular bundles are separate and distinct, as in Figure 303, being connected only by a ring of cambium, but as growth advances and more bundles are formed to supply the new buds and leaves of the devel-

oping axis, they become crowded into a ring (Fig. 304), which is separated into woody wedges by the threads of pith (medullary rays) that run between them from the center to the cortex. The cambium constantly advances outwards, beginning every spring a new season's growth and leaving behind the ring of ducts and woody fibers made the year before.

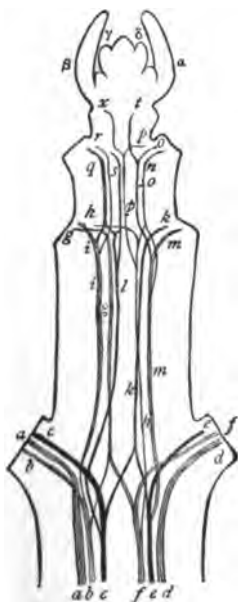
As the work of the plant is most active and its growth most vigorous in spring, the largest ducts are formed then, the tissue becoming closer and finer as the season advances, thus causing the division into annual rings that is so characteristic of dicotyl stems. Each new stratum of growth is made up of the fibrovascular bundles that supply the leaves and buds and branches of the season. Figure 305 gives a diagrammatic section illustrating the passage of the bundles from the leaves to the stem of a dicotyledon, each successive node sending down its quota.



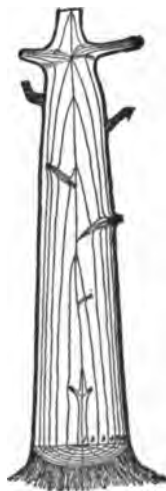
304.—Diagram of an older dicotyl stem, showing bundles confluent into a ring (GRAY).

In this way we see that the increase of dicotyl trunks and branches is approximately in an elongated cone (Fig.

306), the number of rings gradually diminishing toward the top till at the terminal bud of each bough it is reduced to



305. — Diagrammatic view of a leafy stem of clematis, showing the arrangement of the fibrovascular bundles: *a, b, c, — e, f, d*, the fascicles from the lower pair of leaves; *i, g, l, — h, h, m*, the fascicles from the second pair of leaves; *q, r, s, — p, n, o*, the fascicles from the third pair of leaves; *x, t*, fascicles of the fourth pair of leaves; *β, α, — γ, δ*, pairs of undeveloped leaves not as yet having fascicles (GRAY, after NÄGELI).



306. — Diagram illustrating the annual growth of dicotyledons.

a single one, as in the stems of annuals.

Sometimes a late autumn, succeeding a very

dry summer, will cause trees to take on a second growth, and thus form two layers of wood in a single season, so we can not always rely absolutely upon the number of rings in estimating the age of a tree.

225. The Stems of Conifers. — Examine a young stem of pine, and compare with the one just studied. What difference do you notice? This absence of the duct pores constitutes one of the most conspicuous differences between the stems of conifers (cone bearers) and dicotyledons.

The ducts are there, but they are formed differently from those of other exogens, and can not be studied without a compound microscope. From what part of the stem does the rosin exude? Place a cutting in red ink and notice through what part the fluid rises; where, would you judge from this, is the most active part of the stem?

PRACTICAL QUESTIONS

1. Explain the principle upon which boys slip the bark from certain kinds of wood in spring to make whistles. (220.)
2. Why can not they do this in autumn or winter?
3. Name some of the plants commonly used for this purpose.
4. Is the spring, after the buds begin to swell, a good time to prune fruit trees and hedges? Why? (220.)
5. What is the best time, and why?
6. Why are grape vines liable to bleed to death if pruned too late in spring? (220, 221.)
7. Why are nurserymen, in grafting, so careful to make the cambium layer of the graft hit that of the stock? (220.)
8. In calculating the age of a tree or bough from the rings of annual growth should we take a section from near the tip, or the base? Why? (224.)

MOVEMENT OF WATER THROUGH THE STEM

MATERIAL. — An egg, a small cup, and some salt water. A potted young plant of corn, calla lily, *tropæolum*, sunflower, etc. A few centimeters each of glass tubing and rubber tubing about the diameter of the stem of the plant. A twig of willow, currant, or other easily rooting shrub.

226. Difficulty of Accounting for Sap Movement. — Just what causes the rise of sap in the stem is one of the puzzles of vegetable physiology that botanists have not yet been able to solve completely. It is closely connected with the phenomena of transpiration, the rapidity of the current increasing and decreasing according to the activity of the evaporating surfaces. If loss of water begins at any spot through growth or transpiration, the nearest tissues give up their water first, then the more remote, and so on, till the most distant — generally the roots — have to absorb water from without, and thus a constant current is kept up toward the places where moisture is needed.

227. Osmose. — The rise of sap is partly due to the pressure caused by the constant absorption of soil water through the absorbent hairs of the root. The passage of liquids through the walls of cells and tissues is known as *osmose* and takes place when liquids of different densities are separated by a thin membrane, the principle governing the direction of the flow being that the thinner, lighter liquid passes toward the denser. The nature of the substances, also, must be considered; those that are crystalline and easily soluble, like sugar and salt, pass readily through membranes, while gelatinous ones pass with difficulty or not at all.

Chip away a bit of the shell from the big end of an egg, taking care not to injure the thin membrane underneath. Make a small puncture through both shell and membrane in the small end and place the egg in a cup with its big end in salt water. In a few hours the contents will be found running out of the puncture at the other end, having been forced out by the water that made its way in below. And there are no pores visible, even with the most powerful microscope, in the membrane that lines the eggshell.

The same principle is well illustrated by the experiment described in Section 204, the water passing by *osmose* through the walls of the cells that make up the substance of the stem. Take one of the stem sections after it has lain in fresh water, and transfer it to a five per cent solution of salt water (about a tablespoonful of salt to a tumbler of liquid). Allow it to remain as before, and then examine. It will be found to have become straight again, or perhaps even to have coiled over in the opposite direction. This is because the thinner liquid of the cells has passed out by *osmose* into the thicker salt solution, so that the interior cells have become flabby, while the exterior ones, protected by the epidermis, remain distended and thus cause the section to curve inward.

The passage of liquids into a sac or cell is called *endosmose*, out of it, *exosmose*. Which is it that takes place between the soil water and the root?

228. Action of Osmose in the Root. — The sap within the root is generally denser than the water of the soil, so there is a continuous osmotic flow from the latter to the former, but within the stem the fluid is more nearly of the same density throughout and the conditions for osmosis are not so favorable, though it probably does take place to some extent. A more efficient cause is generally held to be the force exerted by the upward pressure of water absorbed into the roots, and known as

229. Root Pressure. — Cover a calla lily, young corn-stalk, sunflower, or other succulent herb with a cap of oiled paper to prevent transpiration, set the pot containing it in a pan of warm water and keep it at a gentle heat. After a few hours look for water drops on the leaves. Where did this water come from? How did it get up into the leaves?

Now cut off the stem of the plant six or eight centimeters (three or four inches) from the base. Slip over the part remaining in the soil a bit of rubber tubing of about the same diameter as the stem, and tie tightly just below the cut. Pour in a little water to keep the stem moist, and slip in above a short piece of tightly fitting glass tubing. Watch the tube for several days and note the rise of water in it. The same phenomenon may be observed in the "bleeding" of rapidly growing, absorbent young shoots, such as grape, sunflower, gourd, tobacco, etc., if cut off near the ground in spring when the earth is warm and moist. This flow can not be due to transpiration, since the leaves and other transpiring parts have been removed. Transpiration, by causing a deficiency of moisture in certain places may influence the direction and rapidity of the current, but does not furnish the motive power, which evidently comes, in part at least, from the roots, and is the expression of their absorbent activity.

230. Root Pressure and Root Pull. — There is no antagonism between these two forces. Root pull affects the body of the plant with its system of tubes and cells; root

pressure affects the free contents of these parts, just as we may sink a water pipe into the ground and at the same time force the water upward through it.

231. Direction of the Current. — Remove a ring of the cortical layer from a twig of any readily rooting dicotyledon, being careful to leave the woody part with the cambium intact. Place the end *below* the cut ring in water, as shown in Figure 307. The leaves above the girdle will remain fresh. How is the water carried to them? How does this agree with the movement of red ink observed in Section 221?

Next prune away the leaves and protect the girdled surface with tin foil, or insert it below the neck of a deep bottle to prevent evaporation and wait until roots develop. Do they come most abundantly from above or below the decorticated ring?

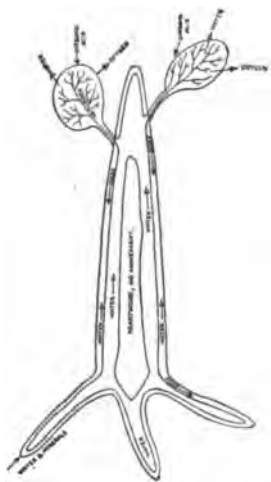
These experiments show that the upward movement of crude sap toward the leaves is mainly through the ducts in the woody portion of the stem, while the downward flow of elaborated sap from the leaves takes place chiefly through the soft bast and certain other vessels of the cortical layer.



307. — A twig which had been kept standing in water after the removal of a ring of cortical tissue: *a*, level of the water; *b*, swelling formed at the upper denudation; *c*, roots.

232. Ringing Fruit Trees. — This explains why farmers sometimes hasten the ripening of fruit by the practice of ringing. As the food material cannot pass below the denuded ring, the parts above become gorged and a process of forcing takes place. The practice, however, is not to be commended, except in rare cases, as it generally leads to the death of the ringed stem. The portion below the ring can receive no nourishment from above, and will gradually be so starved that it can not even act as a carrier of crude sap to the leaves, and so the whole bough will

perish. Figure 308 will give a good general idea of the movement of sap in trees, the arrows indicating the direction of the movement of the different substances.



308.—Diagram showing general movement of sap.

233. Sap Movement not Circulation.—It must not be supposed that this flow of sap in plants is analogous to the circulation of the blood in animals, though frequently spoken of in popular language as the “circulation of the sap.” There is no central organ like the heart to regulate its flow, and the water taken up by the roots does not make a continual circuit of the plant body as the blood does of ours, but is dispersed by a process of general diffusion, part into the air through transpiration, and part through the plant body as food, wherever it is needed.

234. Unexplained Phenomena.—While root pressure will account for the rise of sap to a certain extent, none of the causes assigned by physiologists are sufficient to explain all the phenomena. The highest force as yet proved to be exerted by it is sufficient to balance a column of water only ten to fifteen meters (thirty to fifty feet) high. The power with which it acts seems to vary in different plants. In the nettle it is capable of lifting the sap to a height of about 4.5 meters (15 feet) and in the grapevine more than 11 meters, or about 36.5 feet. It is claimed that in the birch it exerts a lifting force nearly equal to the pressure of a column of water eighty-five feet high, but even this is quite inadequate to explain the rise of sap to the tops of trees three hundred and four hundred feet high, like the giant redwoods of California or the still taller blue gums of Australia. Capillary attraction and the buoyant force of

air bubbles in the cavities of the stem, in conjunction with various other causes, have been called in to explain the phenomenon, but so far as our knowledge goes at present none of them seems to account for it satisfactorily.

PRACTICAL QUESTIONS

1. In pruning, why should the cutting be confined as far as possible to young shoots?
2. Why should vertical shoots be cut off obliquely?
3. Why should pruning not be done in wet weather?
4. Why will a leafy shoot heal more quickly than a bare one? (24, 25, 26, 200.)
5. Why does a transverse cut heal more slowly than a vertical one? (231, 232.)
6. Why does a ragged cut heal less readily than a smooth one?
7. Why does the formation of wood proceed more rapidly as the amount of transpiration is increased? (226.)
8. Why do nurserymen sometimes split the cortex of young trees in summer to promote the formation of wood? (219.)
9. What is the advantage of scraping the stems of trees?
10. Explain the frothy exudations that often appear at the cut ends of firewood, and the singing noise that accompanies it. (215, 224.)
11. What advantage is it to high climbing plants, like grape and trumpet vine (*Tecoma*), to have such large ducts? (214, 215, 221.)
12. Why is the process of layering more apt to be successful if the shoot is bent or twisted at the point where it is desired to make it root?
13. Why do oranges become dry and spongy if allowed to hang on the tree too long? (215, 231, 232.)
14. Why will corn and fodder be so much richer in nourishment if, instead of pulling the fodder when it is mature and leaving the ears to ripen in the field, we cut down the whole stalk and allow both fodder and grain to mature upon it? (215, 231, 233.)
15. Why will inserting the end of a wilted twig in warm water sometimes cause it to revive? (229.)
16. Why should we protect the south side rather than the north side of tree trunks in winter?
17. Why does cotton run all to weed in very wet weather?
18. Why in pruning a branch is it best to make the cut just above a bud?
19. Why is the rim of new bark or callus that forms on the upper side of a horizontal wound thicker than that on the lower side? (231.)
20. Why is it that the medicinal or other special properties of plants are found mostly in the leaves and bark, or parts immediately under the bark? (220, 231.)

WOOD STRUCTURE

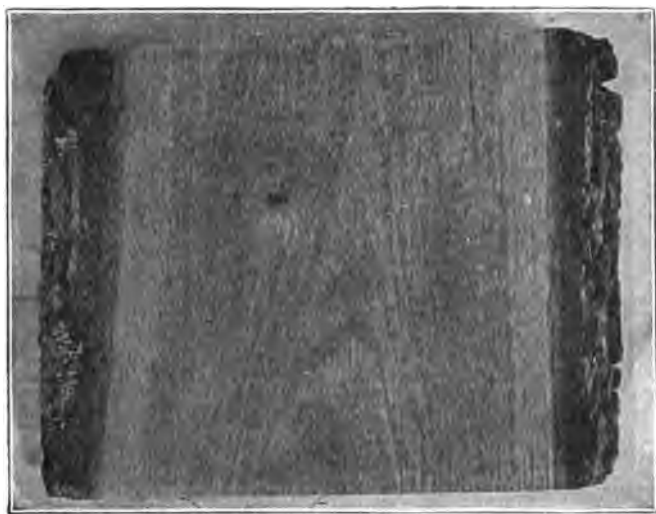
MATERIAL. — Select from the billets of wood cut for the fire, sticks of various kinds; hickory, ash, oak, chestnut, maple, walnut, cherry, pine, cedar, tulip tree, all make good specimens. Red oak shows the medullary rays particularly well. Get sticks of green wood if possible and have them planed smooth at the ends. It would be well for the teacher to have a hatchet and let the class collect their own specimens. Collect also, where they can be obtained, waste bits of dressed lumber from a carpenter or joiner. For city schools prepared samples should be obtained of the dealers. If nothing better is available, any pieces of unpainted woodwork about the schoolroom will furnish subjects for study.



309. — Cross section through a black oak, showing heartwood and sapwood
(from PINCHOT, U. S. Dept. of Agr.).

235. Detailed Structure of a Woody Stem. — Select a good-sized billet of hard wood and count the rings of annual growth. How old was the tree or the bough from which it was taken? Was its growth uniform from year to year? How do you know? Are the rings broadest, as a general thing, toward the center or the circumference? How do

you account for this? Is each separate ring of uniform thickness all the way round? Mention some of the circumstances that might cause a tree to grow less on one side than on the other; such, for instance, as too great shading, lack of foliage development from one cause or another, exposure of roots by denudation, etc. Are the rings of the same thickness in all kinds of wood? Which are the most rapid growers, those with broad or with narrow rings? Do you notice any difference in the texture of the wood in rapid and in slow growing trees? Which makes the better timber as a general thing, and why?

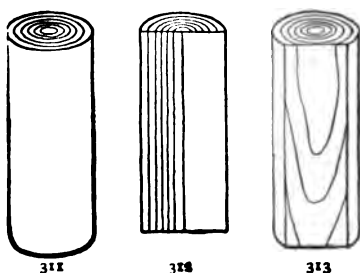


310.— Vertical section through a black oak (from PINCHOT, U.S. Dept. of Agr.).

236. Heartwood and Sapwood. — Notice that in some of your older specimens (cedar, black walnut, barberry, black locust, chestnut, oak, Osage orange, show the difference distinctly) the central part is different in color and texture from the rest. This is because the sap gradually abandons the center (Sec. 224) to feed the outer layers where growth in dicotyls takes place; hence, the outer part of the stem usually consists of sapwood, which is soft and worthless as timber, while the dead interior forms the

durable heartwood so prized by lumbermen. The heartwood is useful to the plant principally in giving strength and firmness to the axis. It will now be seen why girdling a stem, that is, chipping off a ring of the softer parts

all round, will kill it, while we often see vigorous and healthy trees with the center of the trunk entirely hollow.



311-313. — Diagrams of sections of timber: 311, cross section; 312, radial; 313, tangential (from PINCHOT, U.S. Dept. of Agr.).

237. Vertical Arrangement. — In studying the vertical arrangement of stems two sections are necessary, a radial and a tangential one. The former passes along the axis, splitting the stem into halves (Fig. 312); the latter cuts between the axis and the perimeter, splitting off a segment from one side (Fig. 313).

238. The Graining of Timber. — It is the medullary rays that constitute the characteristic graining of different woods. In a chip of red oak or chestnut from just beneath



314. — Tangential section of mountain ash, showing ends of the medullary rays.

the bark their cut ends can be seen very distinctly with the naked eye. Split a thicker chip of the same kind parallel with the medullary rays and notice the difference, the rays now appearing as silvery bands traversing the wood.

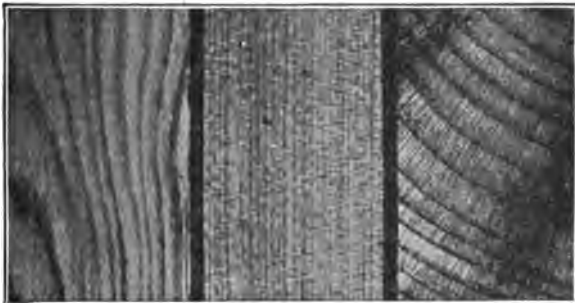
Compare the graining of your specimens, or of the flooring, window casings, doors, desks, benches, etc., of your schoolroom with Figures 312 and 313, and tell what kind



315. — Sections of sycamore wood (from PINCHOT, U.S. Dept. of Agr.):
a, tangential; *b*, radial; *c*, cross.

of cut was made in each case and show how the appearance of the timber has been affected by it.

239. Knots. — Look for a billet with a knot in it. Notice how the rings of growth are disturbed and displaced in its neighborhood. If the knot is a large one, it will itself



316. — Sections of white pine wood (from PINCHOT, U.S. Dept. of Agr.).

have rings of growth. Count them, and tell what its age was when it ceased to grow. Notice where it originates. Count the rings from its point of origin to the center of the stem. How old was the tree when the knot began to form? Count the rings from the origin of the knot to the

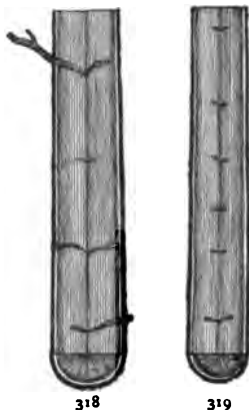
circumference of the stem; how many years has the tree lived since the knot was formed? Does this agree with the age of the knot as deduced from its own rings? (As the tree may continue to live and grow indefinitely after the bough which formed the knot died or was cut away, there will probably be no correspondence between the two sets of rings, especially in the case of old knots that have been covered up



317.—Section of tree trunk showing knot.

and embedded in the wood.)

The longer a dead branch remains on a tree the more rings of growth will form around it before covering it up, and the greater will be the disturbance caused by it. Hence, timber trees should be pruned while very young, and the parts removed should be cut as close as possible to the main branch or trunk. Sometimes knots injure lumber very much by falling out and leaving the holes that are so often seen in pine boards. In other cases, however, when the knots are very small, the irregular markings caused by them add greatly to the beauty of the wood. The peculiar marking of bird's-eye maple is caused by abortive buds buried in the wood.



318, 319.—Diagrams of tree trunks, showing knots of different ages: 318, from tree grown in the open; 319, from tree grown in a dense forest.

PRACTICAL QUESTIONS

1. Name the principal timber trees of your neighborhood. What gives to each its special value?
2. Which is better for timber, a tree grown in the open, or one in a forest, and why? (239.)
3. What are the objects to be attained in pruning timber trees? Orchard and ornamental trees?



320.—Timber tree spoiled by standing too much alone in early youth (from PINCHOT, U. S. Dept. of Agr.). Notice how the crowded young timber in the background is righting itself, the lower branches dying off early from overshadowing, leaving tall, straight, clean boles.

4. What is the difference between timber and lumber? Between a plank and a board? Between a log, stick, block, and billet?
5. Is the outer bark of any use to a tree, and if so, what? (176, 219.)
6. Why does sapwood decay more quickly than heartwood?

FIELD WORK

Make a study of the various climbing plants of your neighborhood with reference to their modes of ascent, and the effect, injurious, or other, upon the plants they cling to. Note the direction of twining stems and tendrils, and their various adaptations to their office. Consider whether the twining habit might not lead to parasitism, especially in the case of soft-stemmed twiners when brought into contact with soft-stemmed annuals. Observe the various habits of stem growth; prostrate, declined, ascending, etc., and see what adaptation to circumstances can be detected in each case.

Notice the shape of the different stems met with, and learn to recognize the forms peculiar to certain of the great families. Observe the various appliances for defense and protection with which they are provided, and try to find out the meaning of the numerous grooves, ridges, hairs, prickles, and secretions that are found on stems. Always be on the alert for transformations, and learn to recognize a stem under any disguise, whether thorn, tendril, foliage, water holder, etc.

Note the color and texture of the bark of the different trees you see, and learn to distinguish the most important by it. Observe the difference in texture and appearance of the bark on old and young boughs of the same species. Try to account for the varying thickness of the bark on different trees and on different parts of the same tree. Farmers are generally engaged in clearing and pruning at this season, and it will probably not be difficult to get all the specimens needed among the rubbish they are clearing away. Notice the difference in the timber of the same species when grown in different soils, at different ages of the tree, and in healthy and weakly specimens.

VII. BUDS AND BRANCHES

BRANCHING STEMS

MATERIAL.—Twigs of hickory and buckeye, or other alternate and opposite leaved plants with well-developed terminal buds. A larger bough of each should also be provided, and where practicable, twigs of several different kinds for comparison. Lilac, horse-chestnut, maple, ash, viburnum, are good examples of opposite buds.

240. Modes of Branching.—Compare the arrangement of the boughs on a pine, cedar, magnolia, etc., with those of the elm, maple, apple, or any of our common deciduous trees. Draw a diagram of each showing the two modes of growth. The first represents the *excurrent* kind, from the Latin *excurrere*, to run out; the second, in which the trunk seems to divide at a certain point and flow away and lose itself in the branches, is called *deliquescent*, from the Latin *deliquescere*, to melt or flow away. The great



321.—Diagram of excurrent growth.



322.—Diagram of deliquescent growth.

majority of stems, as a little observation will show, present a mixture of the two modes.

241. Terminal and Axillary Buds.—Notice the large bud at the end of a twig of hickory, sweet gum, beech, cottonwood, etc. This is called the *terminal* bud because

it terminates its branch. Notice the leaf scars on your twig, and look for the small buds just above them.



323. — Young bud of hickory (*after* GRAY): *t*, terminal bud; *rs*, ring of scars left by bud scales of previous year; *s*, leaf scars; *l*, lenticels; *tr*, leaf traces.

These are *lateral*, or *axillary* buds, so called because they spring from the axils of the leaves. How many leaves did your twig bear? How many ranked? What difference in size do you notice between the terminal and lateral buds?

242. The Leaf Scars. — Examine the leaf scars with a hand lens, and observe the number and position of the little dots in them. (*Ailanthus*, varnish tree, and china tree show these very distinctly.) Refer to Section 219, and say what these dots are.

243. Bud Scales and Scars. — Notice the stout, hard scales by which all the buds are covered. Pull these away from the terminal one and notice the ring of scars that they leave around the base of the bud. Look lower down on your twig for a ring of similar scars left from last year's bud. Is there any difference in the appearance of the bark above and below this ring? If so, what is it, and how do you account for it? Is there more than one of these rings of scars on your twig, and if so, how many? How old is the twig and how much did it grow each year? Has its growth been uniform or did it grow more in some years than others?

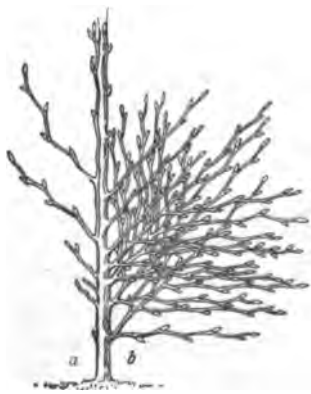
244. Different Rates of Growth. — Notice the very great difference between branches in this respect. Sometimes the main axis of a shoot will have lengthened from twenty to fifty centimeters (eight to twenty inches) or more in a single season, while some of the lateral ones will have grown but an inch or two in four or five seasons. One reason of this is because the terminal bud, being on one of the great trunk lines of sap movement, gets a larger share of nourishment than the rest, and being stronger and better

developed, starts out in life with superior advantages of position. Then, too, in ordinary upright stems the sap flow is strongest in the upper part of the stem, as may be shown by selecting two healthy seedlings as nearly as may be of the same size and height, inverting one of them as described in Section 159, and keeping it in this position for several days by tying or by attaching a weight to it, while leaving the other upright. Watch their growth for a week or ten days and note results.

Make a drawing of your specimen, showing all the points brought out in the examination just made. Cut sections above and below a set of bud scars and count the rings of annual growth in each section. What is the age of each? How does this agree with your calculation from the number of scar rings?

245. Irregularities. — Take a larger bough of the same kind that you have been studying, and observe whether the arrangement of branches on it corresponds with the arrangement of buds on the twig. Did all the buds develop into branches? Do those that did develop all correspond in size and vigor? If all the buds developed, how many branches would a tree produce every year?

In the elm, linden, beech, hornbeam, hazelnut, willow, and various other plants, the terminal bud always dies and the one next in order takes its place, giving rise to the more or less zigzag axis that generally characterizes trees of these species.



324. — Bud development of beech: *a*, as it is, many buds failing to develop; *b*, as it would be if all the buds were to live.

246. Forked Stems. — Take a twig of buckeye, horse-chestnut, or lilac, and make a careful sketch of it, show-

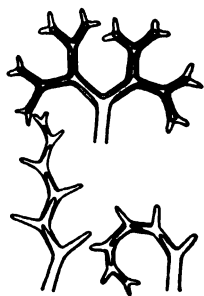
ing all the points that were brought out in the examination of your previous specimen. Which is the larger, the lateral or the terminal bud? (If lilac is used, there will probably be no terminal bud.) Is their arrangement alternate or opposite? What was the leaf arrangement? Count the dots in the leaf scars; are they the same in all? If all the buds had developed into branches, how many would spring from a node? Look for the rings of scars left by the last season's bud scales. Do you find any twig of more than one year's growth, as measured by the scar rings?



325.—Opposite-leaved twig of horse-chestnut.

Look down between the forks of a branched stem for a round scar. This is not a leaf scar, as we can see by its shape, but one left by the last season's flower cluster. The flower, as we all know, dies after perfecting its fruit, and so a flower bud can not continue the growth of its axis, as other buds do, but has just the opposite effect and stops all further growth in that direction. Hence, stems and branches that end in a flower bud can never develop either excurrent or ordinary deliquescent growth, but are characterized by short branches and frequent forking. The same thing happens when, for any reason, the terminal bud is destroyed or injured either artificially, or through natural processes, as in the lilac, where it is frequently aborted and its place usurped by the two nearest lateral ones, which put forth on each side of it and continue the growth of the branch in two forks instead of a single axis. This gives rise to the kind of branching which we see exemplified in the lilac, buckeye, horse-chestnut, dogwood, jimson weed, etc., designated by botanists as *dichotomous*, or two-forked.

Draw a diagram of the buckeye, or other dichotomous

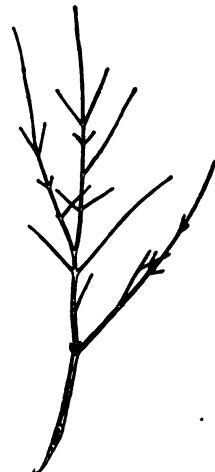


326.—Diagrams of dichotomous branching.

stem as it would be if all the buds developed into branches, and compare it with your diagrams of excurrent and deliquescent growth.

247. Definite and Indefinite Annual Growth. — The presence or absence of terminal buds gives rise to another important distinction in plant development — that of *definite* and *indefinite* annual growth. Compare with any of the twigs just examined, a branch of rose, honey locust, sumac, mulberry, etc., and note the difference in their modes of termination. The first kind, where the bough completes its season's increase in a definite time and then devotes its energies to developing a strong terminal bud to begin the next year's work with, are said to make a *definite* or *determinate annual growth*. Those plants, on the other hand, which make no provision for the future but go straight on flourishing and rejoicing, like the grasshopper in the fable, till the cold comes and literally nips them in the bud, are *indefinite*, or *indeterminate* annual growers. Notice the effect of this habit upon their mode of branching. The buds toward the end of each shoot, being the youngest and tenderest, are most readily killed off by frost or other accident, and hence the new branches spring mostly from the older and stronger buds near the base of the stem. It is this mode of branching that gives to plants of this class their peculiar bushy aspect. Such shrubs generally make good hedges on account of their thick undergrowth. The same effect can be produced artificially by pruning.

248. Differences in the Branching of Trees. — We are now prepared to understand something about the causes of that endless variety in the spread of bough and sweep of woody spray that makes the winter woods so beautiful.



327. — Winter spray of ash, an opposite-leaved tree.

Where the terminal bud is undisputed monarch of the bough, as in the pine and fir, or where it is so strong and vigorous as to overpower its weaker brethren and



328. — Winter spray of elm.

keep the lead, as in the magnolia and holly, we have excurrent growth. In plants like the oak and apple, on the other hand, where all the buds have a more nearly equal chance, the lateral branches show more vigor and the result is either deliquescent growth, or a mixture of the two kinds. In the elm and beech, where the usurping pseudo-terminal bud keeps the mastery, but does not completely

overpower its weaker brethren, we find the long, sweeping, delicate spray characteristic of those species. Examine a sprig of elm and notice further that the flower buds are all down near the base of the stem, while the leaf buds are near the tip. The chief development of the season's growth is thus thrown toward the end of the branch, giving rise to that fine, feathery spray which makes the elm an even more beautiful object in winter than in summer.

An examination of the twigs of other trees will bring out the various peculiarities that affect their mode of branching. The angle, for instance, which a twig makes with its bough has a great effect in shaping the contour of the tree. As a general thing, acute angles produce slender, flowing effects; right, or obtuse angles, more bold and rugged outlines.

PRACTICAL QUESTIONS

1. Has the arrangement of leaves on a twig anything to do with the way a tree is branched? (68, 241.)
2. Why do most large trees tend to assume the excurrent, or axial mode of growth if let alone? (244.)
3. If you wished to alter the mode of growth, or to produce what nurserymen call a low-headed tree, how would you prune it? (246, 247.)
4. Would you top a timber tree? (246, 247.)

5. Are low-headed or tall trees best for an orchard?
6. Why is the growth of annuals generally indefinite?
7. Name some trees of your neighborhood that are conspicuous for their graceful winter spray.
8. Name some that are characterized by the sharpness and boldness of their outlines.
9. Account for the peculiarities in each.

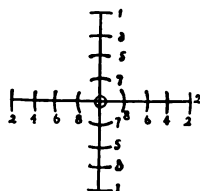
BUDS

MATERIAL. — Expanding buds of any of the kinds used in Sections 240–248 and of tulip tree, magnolia, or other plant with stipular leaf scales. The buds should be in different stages of development, some of them partly expanded. Beech, elm, oak, sycamore, hackberry, fig, will any of them serve as examples of stipular scales, but it is advisable always to use the largest buds obtainable. City schools might get a young India rubber tree from a nursery, or buds of cultivated magnolia from a florist. Gummy buds like horse-chestnut and Lombardy poplar should be soaked in warm water before dissecting, to soften the gum. Buds with heavy fur on the scales, or on the parts within them, can not very well be studied in section, but the parts must be taken out and examined separately. Where material is scarce, the twigs used in Sections 240–248 can be placed in water and kept until the buds begin to expand.

249. Study of an Opposite-Leaved Bud. — Examine a twig of buckeye, horse-chestnut, lilac, or maple, etc., just as the buds are beginning to unfold. Make an enlarged sketch of the terminal one (in the lilac, usually two), showing the relative size and position of the scales.

250. Arrangement of the Scales. —

Notice the manner in which the scales overlap, so as to break joints, like shingles on the roof of a house. Leaves or scales that overlap in this way are said to be *imbricated*. Where the



leaves are opposite, as in the specimen we are examining, the manner of imbrication is very simple. Remove the scales one by one, representing the number and position of the pairs by a diagram after the model given in Figure 329. (If the scales are too brittle to be removed without

breaking, use a bud that has been soaked in warm water for an hour or two.) How many pairs of scales are there in each set? How does their arrangement correspond with that of the leaf scars upon the stem? What difference in size and texture do you observe between the outer and inner scales?



330. — Development of the parts of the bud in the buckeye (after GRAY).

251. Nature of the Scales. — Hold up to the light one of the scales from a partly expanded bud and see whether it is veined, and in what way. Does this correspond with the venation of foliage leaves? Can you make out what the scales represent? Their arrangement is the same as that of the leaves, so they must represent the leaf or some part of it, as the petiole or the stipules. In the lilac and various other buds they are found in all stages of transition from scales to true leaves, from which their real nature may readily be inferred. In the common buckeye and the horse-chestnut the transition is not so apparent, but a comparison with Figure 330 will show that they are altered petioles.

252. Use of the Scales. — What purpose do the scales serve? You can best answer this question by asking yourself what is the use of the shingles on the roof of a house, or of the cloaks with which we wrap ourselves in winter? Notice how thick and hard the outer ones are, and how the inner ones envelop the tender parts within like blankets. As we sometimes coat our roofs with tar and cement, so these scales, especially in cold climates, are often coated with gum for greater security against the weather.

253. Internal Structure of the Bud. — Make a cross section of a bud and sketch it as it appears under the lens.

Next draw a vertical section, then remove the contents and see what they are. There will be no difficulty in recognizing the circle of young leaves just within the scales. How many of these rudimentary leaves are there? Is their arrangement alternate or opposite? Notice the down with which they are covered (in the horse-chestnut and buckeye). Have the mature leaves of these plants any covering of this sort? What is its use here?

254. Folding of the Leaves.— Notice the manner in which the young leaves are folded in the bud. This is called by botanists *vernation*, or *prefoliation*, words meaning respectively "spring condition" and "condition preceding the leaf." Leaves have to be packed in the bud so as to occupy the least space possible, and in different plants they will be found folded in a great many different ways, as is best suited to the shape and texture of the leaf and the space available for it in the bud. When doubled back and forth like a fan, or crumpled and folded as in the buckeye, horse-chestnut, and maple, the vernation is *plicate* (Fig. 332).

255. Position of the Flower Cluster.— What do you find within the circle of leaves? Examine one of the smaller axillary buds, and see if you find the same object within it. If you are in any doubt as to what this object is, examine a bud that is more expanded and you will have no difficulty in recognizing it as a rudimentary flower cluster. Notice its position with reference to the scales and leaves. Being at the center of the bud, it will, of course, terminate its axis when the bud expands, and the growth of the branch will culminate in the flower. The branching of the buckeye (or horse-chestnut) must, then, be of what order?



331, 332. — Buds of maple: 331, vertical section of a twig; 332, cross section through an end bud, showing folded leaves in center and scales surrounding them.

Compare your drawings with the section of a hyacinth bulb or jonquil, and note the similarity in position of the flower clusters.



333.—Cross section of a leaf bud of the rose, showing the alternate arrangement of scales and rudimentary leaves: *A*, growing point; *L*¹, youngest leaf; *L*², three folded lobes of second leaf; *Sc*², stipules of second leaf; *Sc*¹–*Sc*⁶, scales.

256. Study of an Alternate-Leaved Bud.—Examine a large terminal bud of hickory, just about to open. (Apple, pear, cherry, etc., may be substituted if necessary.) How do the scales differ in shape and texture from those already examined? Pick off the scales one by one, noting their position carefully and illustrating it by a diagram, as shown in Figure 333. This is another variety of the imbricated arrangement, and is by far the most common,

though much less simple than that of opposite-leaved buds. How does it correspond with the arrangement of leaf scars on the stem? Refer to Section 52, and say to what order of phyllotaxy it belongs. Notice the gradual change in the size and appearance of the scales from the outside toward the center. Can you give any reasons for regarding them as transformed leaves? Sketch the bud in cross and vertical section (unless this is impracticable on account of the fur) and then remove the contents. Notice the copious fur on the inner scales; of what use is it? Examine with a lens the little furry bodies within the scales and see if you can tell what they are; if you can not, get a bud that is partly unfolded and you will probably have no trouble in recognizing them as rudimentary leaves.



334.—Vertical section of hickory bud; *a*, furry inner scales; *b*, outer scales; *l*, folded leaf; *r*, receptacle.

Notice the manner in which the separate leaflets are folded in the bud and make a diagram of it; how does it differ from that of the buckeye? (Vernation is always best observed in partly expanded buds.) This kind of vernation, in which each leaf or leaflet is rolled over from one side to the other, is called *convolute*. Plum, apple, canna, calla lily, offer good examples of it.

Are there any flower clusters in your hickory bud? if not, look for one that has them. Are they axillary or terminal? Will they stop the further development of their branch? Why or why not?



335. — Expanding bud of English walnut, showing twice conduplicate vernation.

257. Buds with Stipular Scales. — Sketch a bud of the tulip tree, or other magnolia, on the outside. (The India rubber tree, oak, beech, and hackberry, furnish other examples of stipular scales.) How does it differ in appearance from the ones already examined? Remove the outer pair of scales and observe that (in the tulip tree) their edges do not overlap as in the imbricated arrangement, but merely touch, or in botanical language, are *valvate*. Notice the difference in color between the outer and inner scales. Why are the outer pair so hard and thick? Draw a cross section of the bud as it appears under the lens, showing the small round objects that appear here and there between the scales. Can you make out what they are? Draw a vertical section. Do you see anything like a flower bud? If



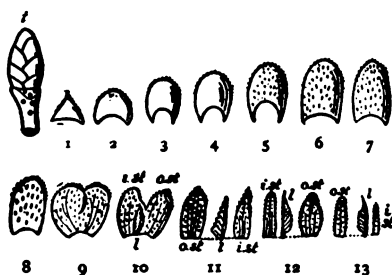
336. — Bud of tulip tree, showing stipular scales: s, s, stipules.



337. — Diagram of tulip tree bud in cross section, showing successive leaves (1-7) with stipules (St. 5, etc.).

so, is it a cluster or a single flower? (Terminal buds in the tulip tree are usually, but not always, flower buds.) Remove the next pair of scales and notice the rudimentary leaf between them. This outer leaf is often found to be dead; can you account for the fact? Pick off the successive pairs of scales, noticing the leaf between them. Observe that the footstalk of each originates *between* the bases of the scales. You will have no difficulty now in identifying the little round dots in your cross section as the cut ends of the petioles. How many pairs of scales are there in the bud? How many leaflets? Study their arrangement and compare it with the diagram (Fig. 337). How does this correspond with the arrangement of leaves on the stem? Do you find any clusters of bud scale scars as in the other specimens examined?

258. What the Scales are. — The bud scales here clearly can not represent leaves. Compare their position at the foot of the petiole with what was said in Section 32 regard-

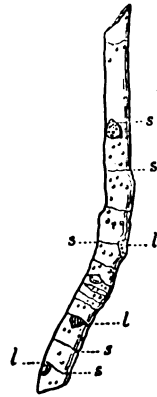


338. — Elm bud with succession of scales: 1, terminal bud. The scales are numbered in successive order as they occur at the nodes. 9 shows two stipular scales partly fused into one; 10, an outer and an inner stipule, *o. st* and *i. st*, with a rudimentary leaf between; 11, 12, and 13, the same. All are separated to show outline.

ing the stipules, and decide what they are. Notice that the two hard outer ones have no leaflet between them; this is because they are the stipules left by the last leaf of the preceding season, which persist on the stem, though the others usually fall away soon after the leaves develop.

In the elm each scale represents a pair of stipules, as will be evident by observing that they are often notched or bifid at the top, and that the rudimentary leaves stand opposite their scales instead of between them.

259. Arrangement of Scars. — Examine the leaf scars at the nodes of a twig of tulip tree, fig, or magnolia, and notice the ring encircling the stem at each (Fig. 339). These are the scars left by the stipular scales of the past season as they fell away. Where a pair of scales is attached with each separate leaf, they are carried apart as the nodes lengthen, and thus the scars are scattered, a pair at each node all along the stem, instead of being compacted into bands at the base of the bud. They are sometimes very persistent, as in the common fig, where they may often be traced distinctly on stems ten to fifteen years old.



339. — Stem of tulip tree: *s, s*, scars left by stipular scales; *l, l*, leaf scars.



340. — A partly expanded leaf of beech, showing plicate-conduplicate vernation.

260. Vernation. — Notice how the two halves of the leaflets are doubled together by their inner faces and then bent over on the petiole (Fig. 336). The first is called *conduplicate*, and is common in the redbud, rose, peach, cherry, oak, Japan quince, etc.; the second is the *inflexed* mode of vernation.

This mixed vernation is very common. In the elm and beech the two halves of the leaf are first plicate and then conduplicate to each other (Fig. 340); in the purple magnolia and chinquapin they are conduplicate-plicate.



341-345. — Diagrams of vernation: 341, conduplicate (oak); 342, convolute (cherry); 343, revolute (dock); 344, involute (balsam poplar); 345, plicate (sycamore).

261. Forms of Vernation. — The varieties of vernalion or prefoliation should be studied and diagrammed as they are met with. In addition to the varieties already mentioned, there are the

Straight: not bent or folded in any way, as Japan honeysuckle, periwinkle, St. John's-wort, dogwood, etc.

Involute (Fig. 344): violet, arrow grass (*Sagittaria*), lotus, water lily, balm of Gilead.

Revolute (Fig. 343): dock, willow oak, scarlet morning-glory (*Ipomea coccinea*), rosemary, azalea, persimmon.

Circinate (Fig. 346): ferns, sundew.



346. — Circinate bud of fern.

262. Dormant Buds. — A bud may often lie dormant for months or even years, and then, through the injury or destruction of its stronger rivals, or some other favoring cause, develop into a branch. Such buds are said to be *latent* or *dormant*. The sprouts that often put up from the stumps of felled trees originate from this source.

263. Supernumerary Buds. — Where more than one bud develops at a node, as is so often the case in the oak, maple, honey locust, etc., all except the normal one in the axil are *supernumerary* or *accessory*. These must not be confounded with *adventitious* buds, or those that occur elsewhere than at a node.



347. — Twig of red maple, showing supernumerary bud, *b*; *rs*, ring of scars left by last year's bud scales (after GRAY).

PRACTICAL QUESTIONS

1. Why do annuals and herbaceous plants generally have unprotected buds? (252.)
2. Why is the gummy coating found on the buds of the horse-chestnut and balm of Gilead wanting in their southern representatives, the buckeye and silver poplar? (252.)

3. Can you name any plants the buds of which serve as food for man?
4. How do flower buds differ in shape from leaf buds?
5. At what season can the leaf bud and the flower bud first be distinguished?
6. Watch any of the trees about your home and see when the buds that are to develop into leaves and flowers the next year are formed.

INFLORESCENCE

MATERIAL. — A few typical flower clusters illustrating the definite and indefinite modes of inflorescence. Some of those mentioned in the text are : —

Indefinite : hyacinth, shepherd's purse, wall flower, parsley, lilac, blue grass, smartweed (*Polygonum*), wheat, oak, willow, clover.

Definite : chickweed, spurge (*Euphorbia*, various kinds), comfrey, dead nettle (*Lamium amplexicaule*), etc. Any other examples illustrating the principal kinds of cluster will do as well, but the subject should not be taught without an examination of at least a few living specimens of each sort.

264. Definitions. — Inflorescence is a term used to denote the position and arrangement of flowers on the stem. It is merely a mode of branching and follows the same laws that govern the branching of ordinary stems.

The stalk that bears a flower is called by botanists the *peduncle*. In a cluster the main axis is the common peduncle, or *rhachis*, and the separate flower stalks *pedicels*.



348. — Solitary terminal flower of a lily.

265. Two Kinds of Inflorescence. — The growth of flower stems, like that of leaf stems, is of two principal kinds, definite and indefinite, or as it is frequently expressed, *determinate* and *indeter-*

minate. The simplest kind of each is the solitary, where a single flower either terminates the main axis, as the daffodil, trillium, magnolia, etc., or springs singly from the axils, as in the running periwinkle, moneywort, and cotton.



349. — Solitary axillary inflorescence of moneywort (after GRAY).

266. Indeterminate Inflorescence is always axillary, since the production of a terminal flower would stop further growth in that direction and thus terminate the development of the axis. We have only to imagine the internodes of such a stem or branch as that represented in Figure 349 very much shortened, the leaves reduced to bracts or wanting altogether, and flowers or flower buds at every node, to have the

267. Raceme, the typical flower cluster of the indefinite sort. In such an arrangement the oldest flowers are, necessarily, at the lower nodes, new ones appearing only as the axis lengthens and produces new internodes. This will be made clear by examining a flowering stalk of hyacinth, cherry laurel (*Prunus Caroliniana*), shepherd's purse, or any common weeds of the mustard family that are generally to be found in abundance everywhere. It will be seen that the lower buds have already fruited in the last named, and perhaps the pods have dehisced and shed their seed before the upper ones have even begun to unfold. Notice the little scale or bract usually found at the base of the pedicel in flower clusters of this sort (in the shepherd's purse it is wanting). This is a reduced leaf, and the fact that the flower stalk springs from the axil, shows it to be of the essential nature of a branch.



350. — Raceme of milk vetch (*Astragalus*).

268. The Corymb.—Imagine the lower pedicels of a raceme to be elongated so as to place their flowers on a level with those of the upper nodes, making a convex, or more or less flat-topped cluster, as in the wall-flower and hawthorn, and we have a modification of the raceme called a *corymb*. In such a cluster the outer blossoms, or those on the circumference, proceed from the lower axils and are, consequently, the oldest; hence, the order of flowering is *centripetal*, that is, from the circumference to the center. This, an inspection of Figure 351 will show, is only another way of saying that it is of the indefinite or indeterminate order.



351. — Corymb of plum blossoms.

269. The Umbel is a still further modification of the raceme. The pedicels with their bracts are all gathered at the top of the peduncle, from which they spread in every direction like the rays of an umbrella, as the name implies. This, though confined to no one group, is the prevalent type of flower cluster in the parsley family, which takes its botanical name, *Umbelliferae*, from its characteristic form of inflorescence. The



352. — Umbel of milkweed.

The pedicels of an umbel are generally called *rays* and the circle of bracts at the base of the cluster is an *involucre*.

270. Compound Clusters.—All these forms of inflorescence may be compound. Most of the parsley family have compound umbels. The lilac, grape, catalpa, and many grasses furnish familiar examples of the *panicle*,



353. — Panicle of a grass.

which is merely a compound raceme, the pedicels of which are branched one or more times.



354. — A spike of the common plantain (*Plantago lanceolata*).

271. A Spike (Fig. 354) is a raceme with the flowers sessile and more or less crowded together, as in the plantain, smartweed, wheat, barley, etc. A form of spike more common in early spring is the

272. Ament, or Catkin, of which we have abundant examples in the pendent scaly inflorescence of the willow, oak, poplar, and most of our common forest trees (Fig. 355). A sessile corymb or umbel gives rise to



355. — Ament or catkin of birch (after GRAY).

273. The Head (Fig. 356), a crowded, roundish cluster like the clover, button-wood, sycamore, etc.



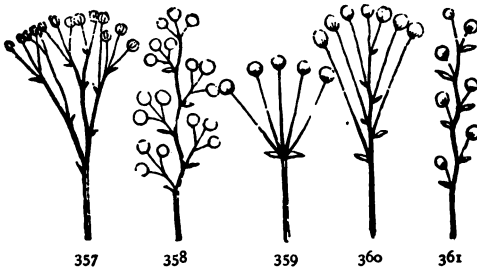
356. — Head of clover.

274. Diagrams. — Do not try to learn all these names by heart, but look for examples of the different kinds of inflorescence and diagram them, using balls or circles to symbolize the flowers, as in the models given in Figures 357 to 361. The order of blooming may be shown by using larger balls to represent

the older flowers. It will be seen from the diagrams that all the forms of indefinite inflorescence are derived from the raceme, whence it is frequently spoken of as the *racemose* type of inflorescence.

275. Cymose, or Definite Inflorescence. — As the raceme is the fundamental form of indefinite inflorescence, so the fundamental form of the definite or determinate kind is

the *cyme*, and hence, the term "cymose" is frequently used as synonymous with determinate or definite.



357-361. — Diagrams of indefinite inflorescence: 357, compound corymb; 358, compound raceme, or panicle; 359, umbel; 360, corymb; 361, raceme.

276. Nature of the Cyme. — To understand the nature of the cyme, study a forking branch of common mouse-ear chickweed (*Cerastium vulgatum*), corn cockle, or spurge (*Euphorbia*). Examine carefully what appears to be the topmost cluster of blossoms, and it will be found to consist of a single terminal flower (probably already gone to seed), with two smaller flower clusters rising from the axils of leaves at the base of the peduncle. The older blossoms in the center, being terminal, stopped the growth of the axis in that direction just as we saw in the case of the terminal flower bud of the buckeye, and forced the stem in continuing its growth to send out side branches from the axils of the topmost leaves. One or both of these branches will produce, or perhaps has already produced, in turn, a terminal flower which forces its branch to divide again, and so on, forking indefinitely in a manner precisely analogous to the dichotomous



362. — Forking cyme of common chickweed.

forking of stems like the buckeye and jimson weed. By looking down in the next lower fork you will probably find the remains of a still older flower that terminated the growth in that direction and forced the stem to continue its development by sending off branches on either side, and so on, until the remains of the older flowers have disappeared and the forking becomes obscured. Here the oldest flower is lowest, not because, as in the raceme, the axis has continued to grow beyond it, but because it checked the further development of its own axis and has been overtopped by new branches.



363. — Flat-topped cyme of sneezeweed.

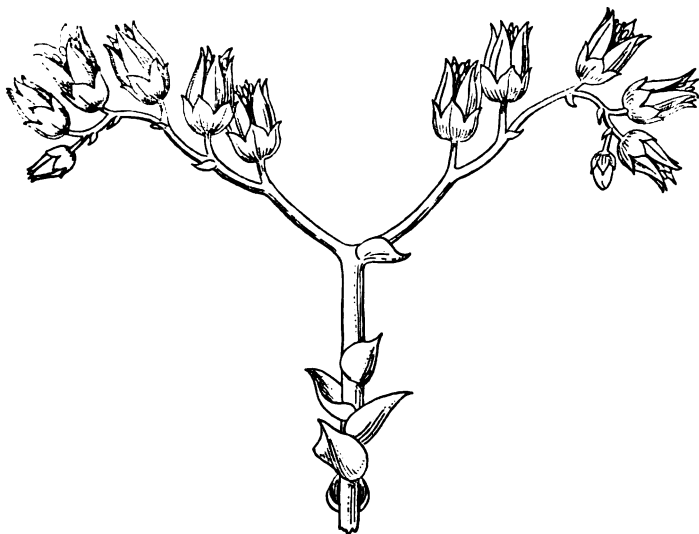
277. Centrifugal Inflorescence. — When the older peduncles are lengthened as described in Section 268, a flat-topped cyme is produced, which is distinguished from the corymb by its *centrifugal* inflorescence; that is, the oldest flower of each cluster is in the center, and the order of blossoming proceeds from within toward the circumference, as in the star-of-Bethlehem, bitterweed (*Helenium tenuifolium*), etc. If the cyme is much compounded, the inflorescence

becomes very complicated, and as many of the blossoms never develop, will seem to have no regular order.

278. The Coiled, or Scorpioid Cyme. — A peculiar form of cyme is found in the coiled inflorescence of the pink-root (*Spigelia*), heliotrope, comfrey, etc. It occurs where a cyme like that represented in Figure 362 develops on one side only. Its structure will be made clear by an inspection of Figures 365–367.

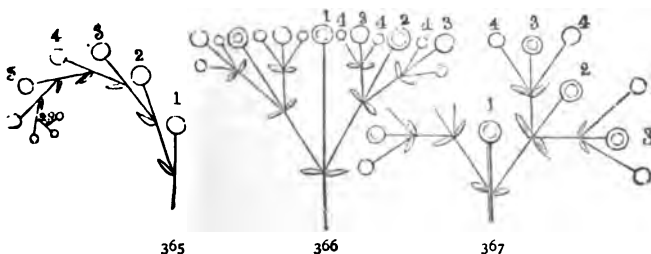
279. Mixed Inflorescence. — We often find the two kinds of inflorescence mixed in the same cluster. In a panicle of buckeye, for example, the whole cluster is terminal with

reference to its shoot, while the secondary branches are indefinite, the lower blooming first. The individual flowers



364. — Scorpioid cyme.

of these secondary clusters, again, are of the definite type, being disposed in scorpioid cymes.



365-367. — Diagrams of cymose inflorescence, with flowers numbered in the order of their development: 365, cyme half developed (scorpioid); 366, a flat-topped or corymbose cyme; 367, development of a typical cyme.

280. Use of Terms. — The distinction between determinate and indeterminate inflorescence is not strictly adhered to in botanical descriptions, especially if the clusters are at all complicated. It is well to remember, however, that

the terms indefinite, indeterminate, racemose, centripetal, all mean about the same thing ; namely, that the flowers develop with the axis, or from below upward ; and the terms definite, determinate, cymose, centrifugal, are employed to denote that the order of inflorescence is contrary to that of the stem growth, and is constantly changing its direction.

281. Significance of the Clustered Arrangement. — As a general thing the clustered arrangement marks a higher stage of development than the solitary, just as in human life the rudest social state is a distinct advance upon the isolated condition of the savage. In plant life it is the beginning of a system of coöperation and division of labor among the associated members of the flower cluster, as will be seen later, when we take up the study of the flower.

PRACTICAL QUESTIONS

1. Name as many solitary flowers as you can think of.
2. Do you find very small flowers, as a rule, solitary, or in clusters?
3. Would the separate flowers of the clover, parsley, or grape, be readily distinguished by the eye from among a mass of foliage?
4. Should you judge from these facts that it is, in general, advantageous to plants for their flowers to be conspicuous?

FIELD WORK

The foregoing lessons are themselves so full of suggestions for field work that it hardly seems necessary to add anything to them.

In connection with Sections 240-248, the characteristic modes of branching of the common trees and shrubs of each neighborhood should be observed and accounted for. The naked branches of the winter woods afford exceptional advantages for studies of this kind, which can not well be carried on except out of doors. Trees should be selected for observation that have not been pruned or tampered with by man. Note the effect of the mode of branching upon the general outline of the tree ; compare the direction and mode of growth of the larger boughs with that of small twigs in the same species and see if there is any general correspondence between them ; note the absence of fine spray on the boughs of large-leaved trees, and account for it. Account for the flat sprays of trees like the elm, beech, hackberry, etc. ;

the irregular stumpy branches of the oak and walnut ; the stiff, straight twigs of the ash ; the zigzag switches of the black locust, Osage orange, elm, linden, etc. Measure the twigs on various species and see if there is any relation between the length and thickness of branches. Notice the different trend of the upper, middle, and lower boughs in most trees and account for it. Observe the mode of branching of as many different species as possible of some of the great botanical groups of trees ; the oaks, hickories, hawthorns, or pines, for instance, and notice whether it is, as a general thing, uniform among the species of the same group, and how it differs from that of other groups.

In connection with Sections 249-263, buds of as many different kinds as possible should be examined with reference to their means of protection, their vernation and phyllotaxy, and the modes of growth resulting from them. Compare the folding of the cotyledons in the seed with the vernation of the same plants, and observe whether the folding is the same throughout a whole group of related plants, or only for the same species. Notice which modes seem to be most prevalent. Select a twig on some tree near your home or your schoolhouse and keep a record of its daily growth from the first sign of the unfolding of its principal bud to the full development of all its leaves. Any study of buds should include an observation of them in all stages of development.

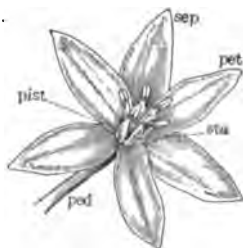
With Sections 264-281, study the inflorescence of the common plants and weeds that happen to be in season, until you have no difficulty in distinguishing between the definite and indefinite sorts, and can refer any ordinary cluster to its proper form. Notice whether there is any tendency to uniformity in the mode of inflorescence among flowers of the same family. Consider how each kind is adapted to the shape and habit of the flowers composing it, and what particular advantage each of the specimens examined derives from the way its flowers are clustered. In cases of mixed inflorescence see if you can discover any reason for the change from one form to the other.

VIII. THE FLOWER

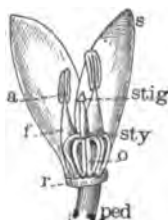
HYPOGYNOUS MONOCOTYLEDONS

MATERIAL.—Any flower of the lily family with disunited petals. Star-of-Bethlehem and yucca are used in the text. Tulip, trillium, dog-tooth violet (*Erythronium*), spiderwort (*Tradescantia*), white lily, all make excellent examples.

282. The Floral Envelopes.—Make a sketch of a flower of the star-of-Bethlehem, or other of the lily tribe, from the outside. Label the head of the peduncle that supports the flower, *receptacle*, or *torus*, the three outer greenish leaves, *sepals*, the three inner, lighter colored ones, *petals*. The sepals taken together form the *calyx*,



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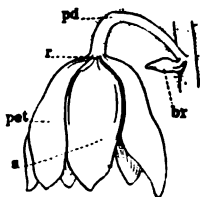
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368-370. — Flower of a hypogynous monocotyledon dissected: 368, a flower of the star-of-Bethlehem, showing the different sets of organs: *pet*, petals; *sep*, sepals; *sta*, stamens; *pist*, pistil; *ped*, peduncle; 369, side view of star-of-Bethlehem with all the petals and sepals but two removed to show order of the parts: *r*, receptacle; *o*, ovary; *sty*, style; *stig*, stigma — parts composing the pistil; *f*, filament; *a*, anther — parts composing the stamen; 370, cross section of the ovary of star-of-Bethlehem: *c*, *c*, carpels; *ov*, ovules; *pl*, placenta.

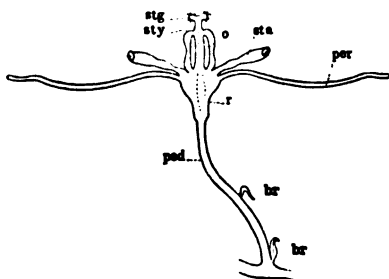
and the petals, the *corolla*. In many flowers, such as the tulip and Atamasco lily (*Zephyranthes*), there is little or no difference between them. In such cases the calyx and corolla together are called the *perianth*, but the distinction of parts is always observed, the three outer divisions

being regarded as sepals, the inner ones as petals. These two sets of organs constitute the *floral envelopes*, and are not essential parts of the flower, as it can fulfill its office of producing fruit and seed without them. Note their mode of attachment to the receptacle and how they alternate with each other.

Remove one of the sepals and one of the petals, and notice any



371. — External view of a yucca blossom: *br*, bract; *pd*, peduncle; *r*, receptacle; *s*, sepal; *pet*, petal.



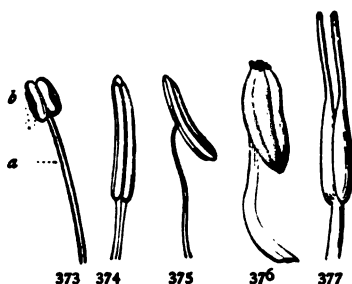
372. — Vertical section of *yucca whipplei*: *ped*, peduncle; *br*, bract; *r*, receptacle; *per*, perianth; *sta*, stamen; *o*, ovary; *sty*, style; *sig*, stigma. The last three parts named compose the pistil.

differences between them as to size, shape, or color. Which is most like a foliage leaf? Hold each up to the light and try to make out the veining. Is it the same as that of the foliage leaves? How many of each are there?

283. The Essential Organs. — Next sketch the flower on its inner face, labeling the six appendages just within the petals, *stamens*, and the central organ within the ring of stamens, *pistil*. These are called essential *organs* because they are necessary to the production of fruit and seed. Note their mode of insertion, three of the stamens alternating with the petals and the other three with these, and with the lobes of the base of the pistil.

284. The Stamens. — Notice whether the stamens are all alike, or whether there are differences as to size, height, shape, color, etc. Do these differences, if there are any, occur indiscriminately and without order, or in regular succession between the alternating stamens? Examine one of the little powdery yellow bodies at the tip

of the stamens, and see whether they face toward the pistil or away from it. In the first case they are said to be *introrse*, in the second, *extrorse*.



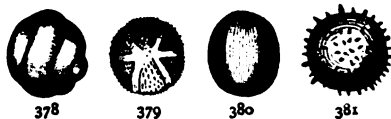
373-377. — Stamens (GRAY): 373, a stamen with the anther, *b*, surmounting the filament, *a* (terminal), and opening in the normal manner down the outer side of each cell; 374, stamen of tulip tree, with adnate extrorse anther; 375, stamen of an evening primrose (*Enothera*) with versatile anther; 376, stamen of pyrula, the anther cells opening by chinks or pores at the top; 377, stamen of a cranberry, with the anther cells prolonged into a tube and opening by a pore at the apex.

Observe the mode of attachment of the anthers, whether by their base merely (*terminal*), or through their entire length (*adnate*), or to the tip of the filament as on a pivot, so as to admit of their turning freely in all directions (*versatile*).

Remove one of the stamens and sketch it as it appears under the lens, labeling the powdery yellow body at the top, *anther*, the stalklike (in the star-

of-Bethlehem expanded and petal-like) body supporting it, *filament*. Usually the filaments are threadlike, whence their name, but in the star-of-Bethlehem they look like altered petals, and frequently a stamen is found in a transition state, as if changing from stamen to petal, or from petal back to stamen. See if you can find such a one. What would you infer from this fact?

Notice the two little sacs or pouches that compose the anther, as to their shape and manner of opening, or dehiscing, to discharge the powder contained in them. This powder is called *pollen*, and will be seen under the lens to consist of little yellow grains. These are of different shapes, colors, and sizes, in different plants, and the surface is often beautifully grooved and striate. The



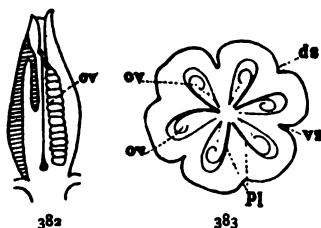
378-381. — Forms of pollen (GRAY): 378, from *mimulus moschatius*; 379, *sicyos*; 380, *echinocystis*; 381, *hibiscus*.

grains with their markings are always alike in the same species, so that it is possible to recognize a plant by its pollen alone. These characters are generally too minute to be observed without a compound microscope, but in the hibiscus, and some others of the mallow family, they can be distinguished with a hand lens.

285. The Pistil. — Remove the stamens and sketch the pistil as it stands on the receptacle. Label the round or oval enlargement at the base, *ovary*, the threadlike appendage rising from its center, *style*, and the tip end of the style, *stigma*. If the stigma is lobed or parted, count the divisions and see if there is any correspondence between them and the number of petals and sepals, or of the lobes of the ovary. Examine the tip with a lens and notice the sticky, mucilaginous exudation that moistens it. Can you think of any use for this? If not, touch one of the powdery anthers to it, and examine it again with the lens. What do you see?

286. Pollination, or the transfer of pollen from the anther to the stigma, is a matter of great importance, as the pistil can not develop seed without it. Note the relative position of pistils and stamens and see if it is such that the pollen can reach the stigma without external agency.

287. The Ovary. — Observe the shape of the ovary, and the number of ridges, or grooves that divide the surface. These lines correspond to the sutures of the fruit, and show of how many carpels the ovary is composed. In the star-of-Bethlehem the ovary has six sutures, three of which represent the midrib of the carpellary leaves, and three



382, 383. — Ovary of *yucca aloifolia*, a hypogynous monocotyledon, dissected: 382, vertical section: *ov*, ovules; 383, diagram of a horizontal section of the same, enlarged, showing the three carpels and six cells, or loculi: *ds*, dorsal sutures; *vs*, ventral sutures; *ov*, ovules; *pl*, placenta.

the inner or ventral sutures, so that there are only three true carpels. Select a flower that has begun to wither, so that the ovary is well developed, cut a cross section near the middle and try to make out the number of cells, or internal divisions. Make an enlarged sketch of the section as it appears under the lens (see Fig. 383), showing the arrangement of the parts, also a longitudinal section (Fig. 382) showing their relative vertical position. Label the little round bodies that represent the undeveloped seeds *ovules*, the surface to which they are attached, *placenta*, and the cavities, or divisions containing them, *cells*, or *loculi* (singular, *loculus*). How many of these are there? Compare these sketches of the ovary with your drawings of dehiscent fruits in Sections 93-109. What correspondences do you notice between them?

As the ovary is merely an undeveloped fruit, and the ovules immature seeds, their structure is the same as that of these parts, and the same terms are used in describing them (Secs. 73-79, and 93-109).

288. Numerical Plan.—Now make a horizontal diagram, after the model given in Figure 384, showing the manner of



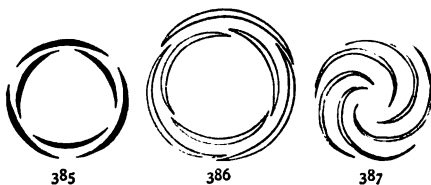
384. — Horizontal diagram of a flower of the lily kind. The dot represents the growing axis of the plant.

attachment of the different cycles — sepals, petals, stamens, and pistils, the number of organs in each set, and their mode of alternation with the organs of the other cycles. Notice that in the star-of-Bethlehem and similar flowers, the parts of each set are in threes, or multiples of three. This is called the numerical plan of the flower, and is the prevailing number among monocotyledons. It is expressed in botanical language by saying that the flower is *trimerous*, a word meaning measured, or divided off into parts of three.

289. Vertical Order. — Next make a vertical diagram of your specimen after the manner shown in Figure 372, and note carefully that the ovary stands *above* the other organs (this is true of all the lily family), and is entirely separate

and distinct from them. In such cases the ovary is said to be *free*, or *superior*, and the other organs *inferior*, or *hypogynous*, a word meaning "inserted under the pistil." These terms should be remembered, as the distinction is an important one in plant evolution.

290. The Flower Bud. — Observe the manner in which the sepals and petals overlap in a partly unfolded bud. Draw a diagram representing their position, as in Figures 385–387. Compare this with your diagrams of leaves and leaf buds; does it agree with any of them, and if so, which? Are the parts imbricated or valvate? (Secs. 250, 256, 257.)



385–387. — Diagrams of three modes of aestivation common among monocotyledons: 385, valvate; 386, imbricate (GRAY); 387, convolute (GRAY).

The arrangement of the parts of the flower in the bud is called *aestivation*, or *prefloration*, words meaning respectively "summer condition" and "condition before flowering." It corresponds to the vernation of leaf buds, and the same terms are used in describing it.

291. Summary of Observations. — In the flower just examined we found that there were four sets of floral organs present — sepals, petals, stamens, and pistil; that the individual organs in each set were alike in size and shape; that there were the same number, or multiples of the same number of parts in each set, and that all the parts of each set were entirely separate and disconnected the one from the other, and from those of the other cycles. Such a flower is said to be: —

Perfect, that is, provided with both kinds of organs essential to the production of seed — stamens, and pistil.

Complete, having all the kinds of organs that a flower can have; viz.: two sets of essential organs, and two sets of floral envelopes.

Regular, having all the parts of each set of the same size and shape.

Symmetrical, having the same number of organs, or multiples of the same number in each set.

The opposites of these terms are: imperfect, incomplete, irregular, and asymmetrical, or unsymmetrical.

Note that regularity refers to form, symmetry to number of parts, and that a flower may be perfect without being complete.

EPIGYNOUS MONOCOTYLEDONS

MATERIAL.— Any flower of the iris or amaryllis families. Iris is used in the text. Blackberry lily (*Belamcanda*), Atamasco lily (*Zephyranthes*), snowdrop, daffodil, narcissus, etc., will make good examples.

292. The Perianth.— Compare with the flower last examined, a common flag, or iris. Notice that the latter has no peduncle, but is sessile in the axil of a large, membranous bract called a *spathe*. Observe also that the lower part of the perianth is united into a long,



388.— Iris flower: *sp*, spathes; *s*, sepals + *p*, petals = perianth.



389.— Vertical section of iris flower (after GRAY): *ov*, ovules; *pl*, placenta; *tu*, tube of the perianth inclosing the style; *sta*, stamen; *sti*, stigma.

narrow tube, from the top of which the sepals and petals extend as long, curving lobes. Where the parts of a perianth or of a corolla are united in this way, whether throughout their whole length, as in the morning-glory, or by a mere thread or rim at the base, as in the

water pimpernel, it is said to be *sympetalous*, meaning "of united petals." Monopetalous and gamopetalous are other words used to denote the same thing, and the kindred terms, synsepalous, gamosepalous, etc., are applied to the calyx.

293. Dissection of the Iris. — Sketch the outside of the specimen, labeling the oblong, three-lobed enlargement at the base, *ovary*, the prolongation of the flower above it, *tube of the perianth*, the three outer lobes with the broad sessile bases, *sepals*, the others, with their bases narrowed and bent inward, *petals*. Now turn the flower over and sketch the inside, labeling the three large, petal-like expansions in the center, *stigmas*. Do you see any stamens? Remove one of the sepals and look under the stigma; what do you find there? Notice the little honey pockets at the foot of the stamen. Run the head of your pencil into them and see what would happen to the head of an insect probing for honey.

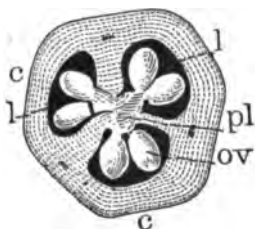
Remove all the petals and sepals and sketch the remaining organs in profile, showing the position of the stamens. Are the anthers extrorse or introrse? What is their mode of dehiscence? Remove a stamen and sketch it. What is the shape of the anther?

Remove as much of the upper part of the perianth tube as you can without injuring the pistil, and with a sharp knife, slice away a section down through the ovary so as to show the long style and its connection with the placenta. Make a sketch of this longitudinal section (see Fig. 389), labeling the long, club-shaped stalk running from the ovary to the stigmas, *style*; the white column in the center of the ovary to which the undeveloped seed are attached, *placenta*, and the unripe seeds, *ovules*. Notice whether the placenta is central or



390.— Vertical section of iris flower, with perianth removed, showing a stamen and three stigmas: *sm*, stigmatic surface.

parietal (Secs. 103, 109). Draw a cross section of the ovary; how many cells has it? Examine with a lens the little flap under the two-cleft apex of one of the stigmas, and



391.—Cross section of ovary of iris flower: *c, c*, carpels; *l, l*, cells, or loculi; *ov*, ovules; *pl*, placenta.

look for a moist spot to which the pollen will adhere. Label this in your longitudinal sketch, *stigmatic surface*. No seeds can be matured unless some of the pollen reaches this surface; can you think by what agency it is carried there? What insects have you seen hovering about the iris? Notice that in drawing his head *out* of the flower, an insect would not touch the stigmatic surface, since it is on the *upper* side of the flap and he would be probing *under* it. But in entering the next flower that he visits, he is likely to strike his head against the flap and turn it under, thus dusting it with pollen brought from another flower.

Sketch a sepal and a petal separately, and note their differences as to shape, color, and texture. Hold each up to the light and observe the veining. If this is not clear, stand a specimen in red ink for two or three hours and examine it again. Is it parallel or net veined? Can you think of a use for the crest of hairlike filaments on the upper side of the sepals?

Examine a bud in cross section. Notice how the sepals and petals overlap, and draw a diagram of the section. This manner of arrangement, where the outer edge of one piece covers the inner edge of the one next above it (Fig. 387), is said to be *convolute*. Draw diagrams showing the horizontal and vertical arrangement of parts in the iris. What is its numerical plan? Is it symmetrical? Regular? Are the parts all free? If not, which are united among themselves or with other sets of organs? Is the ovary above or below the other parts?



392.—Horizontal diagram of iris flower.

294. The Epigynous Arrangement.—In cases of this kind, where the other organs appear to rise from the top of the ovary, they are said to be *epigynous*, a word meaning “upon the ovary.” The same thing is expressed in a different way by saying that the ovary is *inferior*, or that the other organs are *superior*. To make the matter clear, the two sets of terms employed for describing the position of the ovary are given below in parallel columns.

Hypogynous	Epigynous
Ovary superior	Ovary inferior
Calyx or perianth inferior	Calyx or perianth superior

The epigynous arrangement is considered to mark a higher stage of floral development than the hypogynous, which is characteristic of a more simple and primitive structure.

DICOTYLEDONS

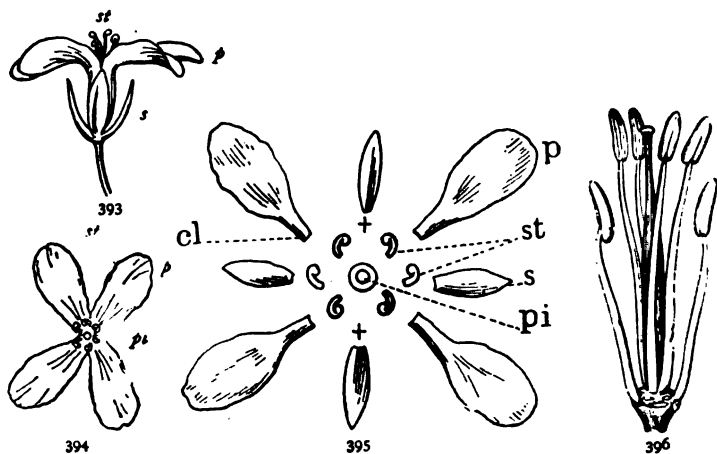
MATERIAL.—Blossoms of any convenient specimens of the mustard family. Large flowered species are always best if they can be obtained; cabbage, mustard, turnip, and wall-flower are very good.

Flowers of apple, pear, or quince, and of peach, plum, cherry, or rose; also of any member of the pea family, such as bean, pea, vetch, black locust, wistaria, etc.

295. Dissection of a Typical Flower.—Gently remove the sepals and petals from a mustard or other cress flower, lay them on the table before you in exactly the order in which they grew on the stem, and sketch them. How many of each are there, and how do they alternate with one another? Sketch the pistil and stamens as they stand on the receptacle; how many of the latter are there? Notice that two of the six are outside and a little below the others, alternate with the petals, while the other four stand opposite them, as is natural if they were alternating with another ring of stamens between themselves and the corolla. Stamens arranged in this way are said to be *tetradynamous*, that is, four stronger, or larger than the others. Put a dot before two of the sepals in your first drawing to

indicate the position of the two outer stamens, and a cross before the other two to show where stamens are wanting to complete the symmetry of this set as in the diagram (Fig. 395). When parts necessary to complete the plan of a flower are wanting, as in this case, they are said to be *obsolete*, *suppressed*, or *aborted*. Place dots before the petals to represent the other four stamens.

Examine the anthers under the lens. Are they extrorse or introrse? What is their mode of attachment to the filament? (Sec. 284.) Sketch one of the anthers, show-



393-396. — A cruciferous flower: 393, side view. 394, view from above. 395, diagram of parts: *p*, petals; *s*, sepals; *st*, stamens; *pi*, pistil; *cl*, claw of petal; +, +, position of the missing stamens. 396, pistil and stamens, enlarged (GRAY).

ing the sagittate base. Remove all the stamens and sketch the pistil, showing the long, slender ovary, the very short style, and the capitate (round and knoblike) stigma. Compare the pistil with a more matured one from an older flower lower down on the stem, and with the descriptions of dehiscent fruits in Sections 93-109, and decide to which kind it belongs. Represent its position by a small circle in the center of your sketch of the separate parts. You have now a complete ground plan of the flower. To what form of leaf arrangement does it correspond? Diagram a vertical section showing the position of the ovary with

reference to the other parts, and report in your notebook as to the following points:—

Numerical plan	Presence or absence of parts
Symmetry	Union of parts
Regularity	Position of ovary

A flower put up on the plan of four, like the one just examined, is said to be *tetramerous*, or four parted. The cress or mustard family gets its botanical name, *Cruciferae*, cross-bearers, from the four opposite petals, which have somewhat the appearance, when viewed from above, of a St. Andrew's Cross. The cruciferous flowers and tetradynamous stamens are striking characteristics of this family, which is so well marked that the merest beginner can hardly fail to recognize any member of it. Notice that its flowers belong to the hypogynous class.

296. Dissection of an Epigynous Dicotyledon.—Sketch a blossom of quince, haw, pear, or apple, first from the outside, then from the inside, and then in vertical section, labeling the parts as in your other sketches. Notice how the ovary is sunk in the hollowed-out receptacle (Sections 74, 77). Where are the other parts attached? Are they inferior or superior? Hold up a petal to the light and examine its venation through a lens. (Use for this purpose a petal from a flower that has stood in red ink for two or three hours. The Cherokee rose petals show venation beautifully.) Is it parallel veined or net veined?

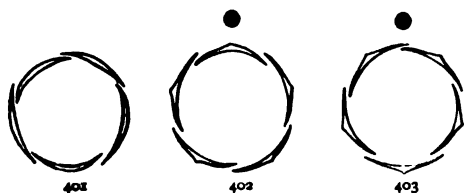


397-400.— Flower and sections of pear: 397, cluster of blossoms, showing inflorescence; 398, vertical section of a flower; 399, ground plan of a flower; 400, vertical section of fruit.

Remove a stamen and sketch it as it appears under the lens. Notice the attachment and shape of the anthers. Are they all of the same color? How do you account for the difference, if there is any? Is the position of the pistil and stamens such that the pollen from the anthers can readily reach the stigmas without external aid? Examine the pistil in flowers of different ages, and see if the stigma is mature (that is, moist and sticky) at the same time that the anthers are discharging their pollen.

Draw a cross section of the ovary and try to make out with a lens the number of cells, or loculi. If you can not succeed, turn to the cross section of the pome made in your study of fruits, and that will settle the question, since the

fruit is merely a ripened ovary.



401-403. — Types of imbricated aestivation common among dicotyledons (after GRAY).

Examine the overlapping of the petals in the bud, and diagram their aestivation (Figs. 401-403).

Compare this with the diagrams of leaf arrangement in Sections 50-52, and decide to which it corresponds.

Diagram the plan of the flower in cross and vertical section. How many parts are there in each set? Can you readily tell the number of stamens? When the individuals of any set or cycle of organs are too numerous to be easily counted, like the stamens of the apple, pear, and peach, or the petals of the water lily, they are said to be *indefinite*. It is very seldom that perfect symmetry is found in all parts of the flower. The stamens and pistil, in particular, show a great tendency to variation, so that the numerical plan is generally determined by the calyx and corolla. Where the parts are in fives, as in the pear, quince, wild rose, etc., the flower is said to be *pentamerous*, or in sets of five.

After drawing the diagrams, write in your notebook answers to the following questions: —

What is the numerical plan of the flower ?

Which of its circles of organs is lacking in symmetry ?

Which sets of organs are adherent to other sets ?

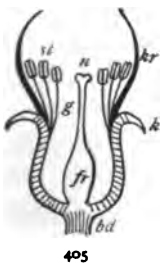
Is the flower epigynous or hypogynous ?

297. Examination of a Perigynous Flower.—Compare with the specimen just examined, a blossom of peach, almond, plum, or cherry. Is its numerical plan the same? Make a diagram showing the arrangement of parts in vertical section. Is the calyx inferior or superior? Where are the petals and stamens inserted?

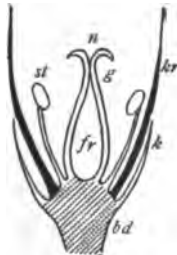
Flowers of this kind, where the ovary is free and the other parts attached to a prolongation of the receptacle containing it, are said to be *perigynous*, meaning "around the pistil." It is intermediate between the hypogynous and epigynous arrangement, sometimes approaching more nearly to the latter, as in the rose, sometimes remaining clearly of the hypogynous type, as



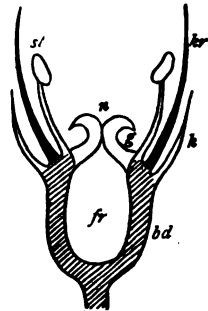
404. — Vertical section of an almond blossom with petals removed, showing the perigynous arrangement.



405



406



407

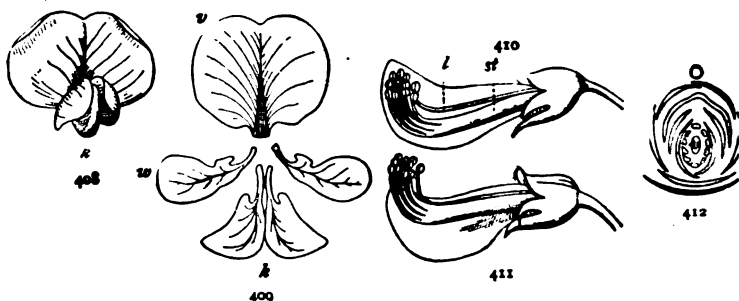
405-407.—Diagrams showing arrangement of parts (*bd*, receptacle; *k*, calyx, *kr*, corolla; *st*, stamens; *fr*, ovary; *g*, style; *n*, stigma): 405, perigynous; 406, hypogynous; 407, epigynous.

in the peach and cherry. In general a flower is not considered epigynous unless the ovary is more or less consolidated with the parts around it.

298. Dissection of an Irregular Flower.—Irregularity is more noticeable in the corolla than in the other parts, and when we speak of an irregular flower the reference is generally to that organ.

Sketch a blossom of any kind of pea or vetch as it appears on the outside. Are the sepals all of the same length and shape? If not, which are the shorter, the upper or lower?

Turn the flower over and examine its inner face. Notice the large, round, and usually upright petal at the back, the two smaller ones on each side, and the boat-



408-412.—Dissection of papilionaceous flowers (after GRAY): 408, front view of a corolla. 409, the petals displayed: *v*, vexillum, or standard; *w*, wings; *k*, keel. 410, side view with all except one of the lower petals removed, showing the essential organs protected in the keel: *l*, loose stamen; *st*, stamen tube. 411, side view, showing how the anthers protrude when the keel is depressed. 412, ground plan.

shaped body between them, formed of two small petals more or less united at the apex. Press the side petals gently down with the thumb and forefinger and notice how the essential organs are forced out from the little boat in which they are concealed. Observe how the end of the style is bent over so as to bring the stigma uppermost when the petals are depressed. Imagine the legs of a bee or a butterfly probing for honey; with what organ would his body first come in contact when he alighted? If his thorax and abdomen had previously become dusted with pollen when visiting another flower, where would the pollen be likely to be deposited?

Remove the sepals and petals from one side and sketch

the flower in longitudinal section, showing the position of the pistil and stamens. Then remove all the petals, and spread in their natural order on the table before you, and sketch as they lie (Fig. 409). Label the large, round upper one, *vexillum*, the smaller pair on each side, *wings*, and the two more or less coherent ones in which the pistil and stamens are contained, *keel*. Corollas of this kind are named *papilionaceous*, from the Latin word *papilio*, a butterfly, on account of their general resemblance to that insect; while the old names are somewhat incongruous, they are descriptive, and answer their purpose sufficiently well to be retained.

299. Dissection (continued). — Count the stamens, and notice how they are united into two sets of nine and one. Stamens united in this way, no matter what the number in each set, are said to be *diadelphous*, that is, in two brotherhoods. Notice the position of the lone brother, whether below the pistil — next to the keel — or above, facing the vexillum. Would the projection of the pistil when the wings are depressed be facilitated to the same extent if the opening in the stamen tube were on the other side, or if the filaments were *monadelphous* — all united into one set? Flatten out the stamen tube, or sheath formed by the united filaments, and sketch it.

Remove all the parts from around the pistil, and sketch it as it stands upon the receptacle. Look through your lens for the stigmatic surface (Sec. 293). See if there are any hairs upon the style, and if so, whether they are on the front, the back, or all around. Can you think of a use for these hairs?

300. Dissection (continued). — Notice how the long, narrow ovary is attached to the receptacle; is it sessile, or raised on a short footstalk? If the latter, label the footstalk *stipe*. Select a well-developed pistil from one of the lower flowers, open the ovary parallel with its flattened sides and sketch the two halves as they appear under the lens. Notice to which side the ovules are attached, the upper (toward the vexillum) or the lower, and label it

plucenta. Which suture of the pod is this (Sec. 98)?



413. — Diagram of aestivation of a papilionaceous corolla.

Compare with your sketches of dehiscent fruits; which one does it resemble?

Examine a bud and diagram the aestivation. Which petal overlaps the others? Diagram the flower in horizontal and vertical section, and decide upon the following points: —

What is the numerical plan?

In what organ or organs is there a departure from symmetry?

In which is there irregularity?

Are all the parts free?

In which set of organs is there union?

Is the flower hypogynous or epigynous?

301. Significance of these Distinctions. — These distinctions are important to remember not only because they are very useful in grouping and classifying plants, but because they mark successive stages in the evolution of the flower. In general, flowers of a primitive type and less advanced organization are characterized by having their organs free and hypogynous, while the more highly developed forms show a tendency to consolidation and union of parts, and the epigynous mode of insertion. Irregularity also, since it indicates specialization and adaptation to a particular purpose, may be regarded as a mark of advanced evolution.

302. Numerical Plan of Dicotyledons. — In all the flowers examined in Sections 295–300 except the first specimen, the organs were found to be in fives, or multiples of five. This is the prevailing number among dicotyledons, though other orders are not uncommon, and occasionally even trimerous forms like the magnolia, pawpaw, etc., are met with. In the mustard family, in the common yellow primroses of our old fields, and in several other well-known species, the tetramerous, or fourfold arrangement prevails, while some of the saxifrages, and a few other plants are *dimerous*, having their parts in twos. For the

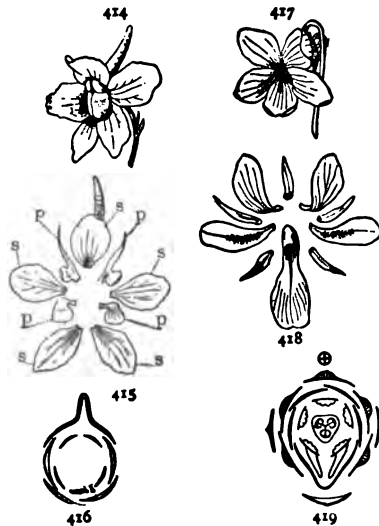
sake of brevity these terms are generally written, in botanical descriptions, 2merous, 3merous, 4merous, 5merous, which are pronounced respectively, dimerous, trimerous, tetramerous, and pentamerous.

THE COROLLA

MATERIAL. — Practical illustrations of Sections 303-318 must be sought for out of doors, by observing the various flowers and weeds with which the student comes in contact in his daily walks.

303. Cohesion and Adhesion. — A flower that is perfectly symmetrical and regular, with all its parts free and distinct, like the star-of-Bethlehem and most of the lily family, is not often met with. Frequently one or more of the organs are wanting; more frequently still they are combined and consolidated in various ways with each other or with organs of a different set. Union between organs of the same set is called *cohesion*; between organs of different kinds, *adhesion*, or *adnation*. The opposite of coherent is *distinct*; of adherent, *free*.

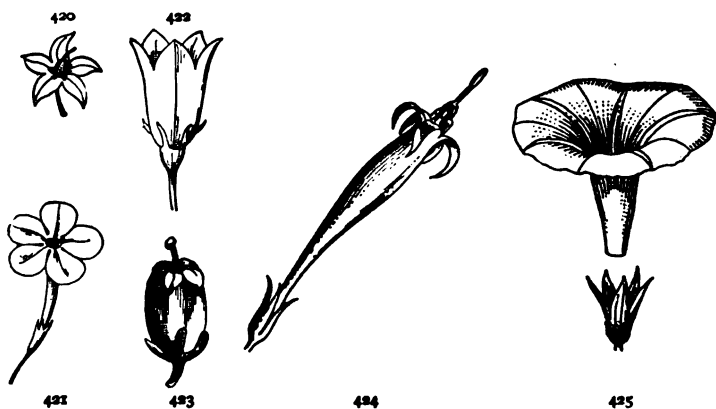
304. Apopetalous and Sympetalous Corollas. — Consolidation may occur between any parts of the flower, either of the same or of different sets, but is more conspicuous in the corolla, so that this character has been made the basis of one of the great divisions of seed-bearing plants, which are classed as *apopetalous* and *sympetalous*, according as their corollas are composed of separate or of united petals. Flowers that have no corolla are



414-419. — Irregular apopetalous corollas (after GRAY): 414, a larkspur flower; 415, sepals, *s*, *s*, and petals, *p*, *p*, displayed; 416, diagram of arrangement; 417, corolla of the violet; 418, sepals and petals displayed; 419, diagram of arrangement.

said to be *apetalous*, that is, without petals. The term *polypetalous* is sometimes used instead of apopetalous.

305. Apopetalous Corollas may have any number of petals, from one or two, as in the enchanter's nightshade (*Circæa*), to the indefinite whorls of such double flowers as the cactus and water lily. They may be of all shapes and sizes, and sometimes present the greatest irregularities of structure, as the violet, tropæolum, larkspur, and columbine. The commonest type of irregular corolla belonging to the apopetalous group, and the only one that has received a special name, is the papilionaceous corolla already described, that characterizes the pea family. This may well be called the reigning family of this division, since it is by far the most important and numerous, containing about seven thousand known species, among which are many of our most useful food plants.



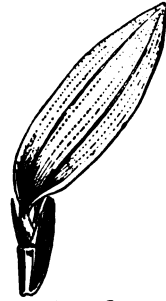
420-425. — Forms of sympetalous corollas (420-422, and 425, after GRAY): 420, rotate corolla of nightshade; 421, salver-shaped corolla of phlox; 422, campanulate corolla of harebell; 423, urceolate, or urn-shaped corolla of andromeda; 424, tubular corolla of spigelia; 425, funnel-shaped corolla of morning-glory.

306. Sympetalous Corollas are of so many different forms that it has been found convenient to apply special names to the more important of them. A correct idea of these can be gained by comparing living specimens as they are found with Figures 420-425.

307. The Ligulate, or strap-shaped corolla, seen in the rays of the sunflower family, is of such frequent occurrence as to deserve a special examination. If you will remove one of the small blossoms from the disk of any large composite flower (Fig. 426) and imagine its corolla greatly enlarged and split open on the inner side, you will get a very good idea of the nature of the

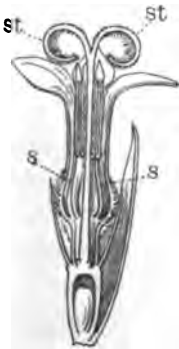


426. — A head of artichoke flower divided lengthwise.



427. — A ray flower of artichoke, enlarged.

rays. The five little teeth into which it is usually cleft at the top show the number of lobes or petals of which it is composed. The corolla of the lobelia represents an intermediate state between the tubular and ligulate forms (Fig. 429).



428. — A vertical section of a disk flower, showing the divided style, *st*, and the stamens, *s, s*, with their anthers united (syngenesious).

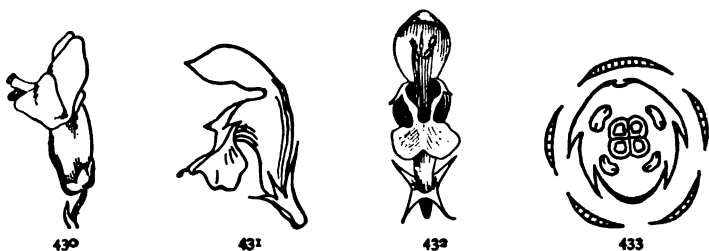


429. — Flower of *Lobelia cardinalis*, with tube of corolla divided on one side; filaments and anthers united into a tube (after GRAY): *f*, tube of filaments; *a*, anthers.

308. Bilabiate Corollas. — By far the most important and widely distributed of sympetalous corollas is the bilabiate, or two-lipped kind, distinctive of the mint and figwort families and their allied groups, numbering in all over six thousand

known species. They are of many varieties, from the scarcely perceptible irregularity of the verbena and mullein to the complicated structures of the sage, snapdragon, and toad flax. Two of them are so strongly marked that they have received special names. These are the *ringent*, or open-mouthed, and the *personate*, or closed (Figs. 430

and 431), so called from a fancied resemblance of the swollen palate to a grotesque *persona*, or mask. The sage and dead nettle are familiar examples of the first, the snapdragon and toadflax of the second. An inspection of the sage or the dead nettle will show that the two lips represent the divisions of a five-lobed sympetalous corolla united into sets of two and three petals respectively. The very divergent appendage of the lower lip represents the middle one of three petals, while the two lateral ones have become greatly reduced, or in the dead nettle, nearly



430-433. — Bilabiate corollas: 430, personate flower of snapdragon (*after* GRAY); 431, ringent corolla of dead nettle; 432, front view; 433, horizontal diagram.

obsolete. The arched upper lip represents two petals confluent into one, a notch in many species (catnip, dittany, snapdragon), indicating the original line of division.

Some of the names given to sympetalous corollas apply equally to apopetalous ones. Chickweed and moonseed are rotate; the *uvularias*, the *yucca*, and the *abutilon* of the greenhouses are bell-shaped, or campanulate; okra and some of the lilies are funnel-shaped.

The same terms that are used in describing the shapes of foliage leaves are applied to the sepals and petals of flowers.

SUPPRESSIONS, ALTERATIONS, AND APPENDAGES

MATERIAL is to be sought for out of doors, wherever it may present itself. Specimens of pine, oak, or other unisexual flowers should be provided for class study. If these are not in season, the mulberry, Osage orange, hop, sycamore, black gum, persimmon, and the gourds, squashes, and melons, furnish good examples of unisexual flowers, one or more of which ought to be examined.

309. Undeveloped Organs. — A flower may depart from the normal type either by the non-development of parts, or through the suppression or alteration of parts already developed. A want of development generally characterizes simple and primitive forms such as the naked flowers of the lizard's tail (*Saururus*), the black ash,



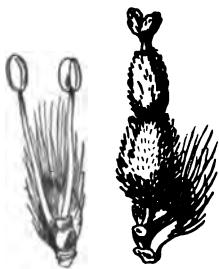
435. — Petal-like sepals of clematis.

and willow, in which the floral envelopes are entirely lacking, or reduced to a mere scale or bract. A step higher in the order of development the floral envelopes appear, but are usually inconspicuous and without differentiation into calyx and corolla, as in the elm, knot-weeds, docks, etc. Where only one set of these organs is present, it is considered a calyx, no matter how large and conspicuous it may be, as in the four-o'clock, and clematis.



434. — Naked flower of *Saururus* (after GRAY).

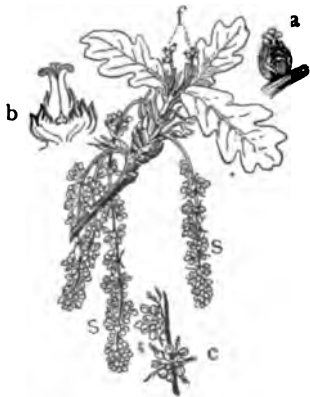
310. Unisexual Flowers. — Where one of the essential organs is lacking, the flower is *unisexual*, which means that either stamens only, or pistils only, occur in the same flower. When the stamens alone are present the flower is said to be staminate, or *sterile* because it is incapable of producing seeds of its own, though its pollen is a necessary factor in their production. If, on the other hand, the ovary is present and the stamens absent, the flower is pistillate and *fertile*; that is, capable of producing fruit when impregnated with pollen. Sometimes both stamens and pistils are wanting, as in the showy corollas of the garden "snowball" and hydrangea, and the rays of the sunflower. Such blossoms are said to be *neutral*, from the Latin word *neuter*, neither, because they have neither pistils nor stamens. They can, of course, have no



436, 437. — Flowers of willow : 436, pistillate ; 437, staminate.

direct part in the production of fruit, but are for show merely. Their show, however, is far from being a vain and empty one, as we shall see in Sections 330–338.

311. Monœcious and Diœcious Plants. — When both kinds of flowers, staminate and pistillate, are borne on the same plant, as in the oak, pine, hickory, and most of our common forest trees, they are said to be *monœcious*, a word which means “belonging to one household,” and *diœcious*, or “of two households,” when borne on separate plants, as in the willow, sassafras, and black gum. Draw a flowering twig of oak, or other amentaceous (ament-bearing) tree. Where are the fertile flowers situated? Notice how very much more numerous the staminate flowers are than the fertile ones.



438. — Twig of oak with both kinds of flowers: *f*, fertile flowers; *s*, *s*, staminate; *a*, pistillate flower, enlarged; *b*, vertical section of pistillate flower, enlarged; *c*, portion of one of the sterile aments, enlarged, showing the clusters of stamens.

312. Advantages of the Unisexual Arrangement. — The absence of parts in a flower is not necessarily a mark of low organization, but may be the result of adaptation to its surroundings. It has been proved by experiment that flowers will generally produce more vigorous and healthy seed when impregnated with pollen from a different plant of the same species, and unisexual flowers promote this result by making it impossible for any blossom to receive pollen from itself.

313. Suppression or Abortion of Organs. — Sometimes this advantage is secured by the suppression of one or the other set of organs in different flowers. In the pistillate flowers of the persimmon the aborted stamens are quite conspicuous, though entirely sterile, producing not a grain of pollen. Rudimentary (undeveloped) organs of this kind

are very common and are a frequent cause of irregularity and want of symmetry, as was seen in the stamens of the cress family (Sec. 295). Suppressed stamens are a common characteristic of the great bilabiate group (Sec. 308), large numbers of species having only two or four, but these are often accompanied, as in the pentstemon, che-lone, and figwort, by sterile filaments in a more or less aborted condition that carry out the law of symmetry indicated in the five-lobed corolla (Sec. 308). The fila-ment and style are often wanting, so that the anther or the stigma becomes sessile. While it is usual to speak of the stamens and pistil as essential organs, it is really only the ovary and the anther, or more strictly speaking, the ovules and pollen that are absolutely essential. The style is merely an ap-pendage for placing the stigma where it will be brought more easily into contact with the pollen, and may be of any length, from a foot or more, as in the "silk" of the Indian corn, to a mere line, or entirely absent, as in the poppy and some of the yuccas.

The study of these rudimentary or discarded organs helps to explain many deviations in the structure of flowers that would otherwise be very puzzling, and by their aid we can often reconstruct the plan of a flower that seems to have lost all conformity to the type.

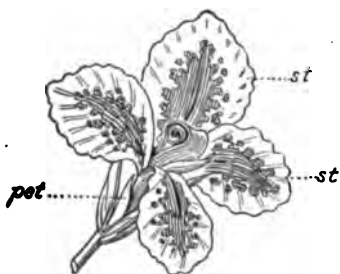
314. Cleistogamic (closed) Flowers are so called because they never unfold, but are pollinated in the bud. Common examples are the inconspicuous closed flowers, on very short peduncles, concealed under the leaves of most violets. Sometimes, as in the fringed polygala, they are borne on underground stems and never rise above ground at



439. 440. — Abortive stamens (after GRAY): 439, corolla of *Pentstemon grandiflorus* laid open, with its four stamens, and a sterile filament in the place of the fifth stamen; 440, corolla of *catalpa* laid open, with two perfect stamens and the vestiges of three abortive ones.

all. The corolla is usually wanting and the stamens and pistil are greatly reduced, but they are much more prolific than ordinary blossoms.

315. Transformations.—Instead of suppression, organs frequently undergo an alteration into something else by



441. — Staminodia, transformed stamens of canna stimulating petals: *pet*, petals; *st*, staminodia.

which their nature is greatly obscured. Conspicuous instances are the brilliant *staminodia*, or altered stamens of the canna, that simulate petals (Fig. 441), and the four large white bracts, usually mistaken for a corolla, that surround the flower clusters

of the dogwood. In the cereus and other cactuses, bracts may be found in all stages of transition, from spines or scales to the most gorgeous of corollas. The rose, camellia, and water lily furnish other instances of the same kind; and in fact, examples of the transition of almost any organ into another may be observed by one who will take the trouble to look for them.



442. — Flower of a cactus (*cereus greggii*), showing transition from scales to petals.

316. Appendages of the Corolla.—An appendage attached to the inner face of the corolla, like the funnel-shaped or bell-shaped projection within the perianth of daffodils and jonquils and others of the amaryllis family, to which they belong, is called a crown. It is no part of the perianth proper, and does not interfere in any way with the symmetry of the flower. The crown of the passion flower, to which so much of its beauty is due, is composed of a ring of abortive filaments, brilliantly colored, that sur-

round the base of the style. In the milkweed (*Asclepias*) the crown itself is appendaged with five little incurved horns.

317. Other Appendages. — Though appendages are most frequently connected with the calyx and corolla, they may attach to any part of the plant. Figure 377 shows an appendaged anther; and the various appliances for dispersal furnish examples of appendaged fruits and seeds. When the appendage is so large as to inclose a whole seed, like the loose transparent sac around the seed of the water lily, and the brilliant scarlet pulp around the seeds of the strawberry bush (*Euonymus americanus*), it is called an *aril*; can you think of a use for it?

318. Use of Appendages. — The offices of these appendages are as varied as the appendages themselves. They may be, as in the case of hairy filaments, to protect the pollen from crawling insects; to keep out rain, dew, or frost; to retain or to shed moisture; to secrete honey, as in the spurs and sacs of the violet and larkspur, or in other ways to attract and repel insects that aid or hinder the dispersal of pollen. As they are generally the result of special adaptations on the part of the plant to its surroundings—more particularly with regard to insect pollination—they are usually indicative of an advanced stage of floral development.

PRACTICAL QUESTIONS

1. Why does a strawberry bed sometimes fail to fruit well, although it may flower abundantly? (310, 311.)
2. Are berries found on all sassafras trees? on all buckthorns? hollies?
3. Would a solitary hop vine produce fruit? A solitary ash tree?
4. Why is a mistletoe bough with berries on it so much harder to find than one with foilage merely? (310, 311.)
5. Explain the nature and use of the appendages in such of the plants named below as you can obtain; crown of the maypop, jonquil, milkweed; spurs of the columbine, tropæolum, jewel weed, etc.; bracts of the dogwood and poinsettia; spathe of Jack-in-the-pulpit and other arums.

NATURE AND OFFICE OF THE FLOWER

MATERIAL. — Any kind of large flower may be used ; those of the hollyhock, okra, cotton, hibiscus, or others of the mallow family are recommended, as their pollen grains are large enough to be observed fairly well with a hand lens. The cultivated Syrian hibiscus is the one used in the text.

319. Flower and Leaf. — We have seen that the venation of petals and sepals corresponds in a general way with that of foliage leaves of the class to which they belong, and that their arrangement around their axis is analogous to the arrangement of foliage leaves on the branch. We learned also, in our study of inflorescence, that flowers and flower buds occur only in the same positions where leaf buds occur, and that they are subject to the same laws of arrangement and growth.

320. Transformation of Organs. — In our study of fruits we saw that the carpels of the ovary are merely transformed leaves. We learned, also, in our study of leaves, something about the wonderful transformations that these organs are capable of undergoing ; and lastly, we have found some of these transformations taking place under our eyes in the leaflike sepals and petal-like filaments of the star-of-Bethlehem, in the bracts of the cactus, the scales of winter buds, and numerous other instances recorded in the preceding pages.

It must not be supposed, however, that an organ is ever developed as one thing and then deliberately changed into something else. When we speak loosely of one organ being transformed into another, the meaning is merely that it has developed into one thing instead of into something else that it was equally capable of developing into.

321. The Flower a Transformed Branch. — For the reasons mentioned, the flower is regarded by botanists as merely a branch with transformed leaves and the internodes indefinitely shortened so as to bring the successive cycles into close contact, the whole being greatly altered and specialized to serve a particular purpose.

322. The Course of Floral Evolution. — With this conception of the nature of the flower we can readily see that the less specialized its organs are and the more nearly they approach in structure and arrangement to the condition of an undifferentiated branch, the more primitive and undeveloped the type to which it belongs. On the other hand, if the parts are highly specialized and widely differentiated from the crude branch, a proportionately high stage of floral evolution is indicated.

323. Office of the Flower. — The one object of the flower is the production of fruit and seed, and all its wonderful specializations and variations of form and color tend either directly or indirectly to that end.

324. Fertilization. — It was stated in Section 286 that no seed can be developed unless some of the pollen reaches the stigma, but even this is not sufficient unless the process known as fertilization takes place. The exact nature of this process it is not easy to explain without going into details beyond the scope of this work, but a good general idea of fertilization may be obtained by referring to Figure 443 in connection with a study of the pollinated pistil of some large flower, like the hollyhock or hibiscus.

325. The Pollen Tubes. — Obtain if possible the flower of a Syrian hibiscus (okra will answer nearly as well) that has begun to close up, or to change color, and compare the stigma with that of a freshly opened flower. What difference do you observe in the pollen grains adherent to each? The yellow, withered look of the former is due to the fact that they have begun to germinate on the moist surface of the stigma; that is, to send down little tubes into its substance (Fig. 443, *i*), and the nourishment contained in the grain is being used up, just as the endosperm of the seed is used up when the embryo begins to germinate. (The germination of pollen, however, means something very different from the germination of the seed, and

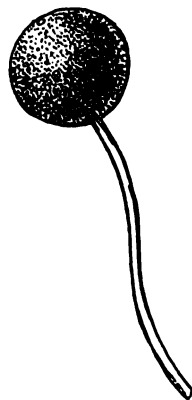
must not be confounded with it.) The pollen tube continues to elongate until it passes down through the base of the style into the ovary (Fig. 443, *m*).



443.—Diagram of a simple flower, showing course of the pollen tube: *a*, transverse section of an anther before its dehiscence; *b*, an anther dehiscing longitudinally, with pollen; *c*, filament; *d*, base of floral leaves; *e*, nectaries; *f*, wall of carpels; *g*, style; *h*, stigma; *i*, germinating pollen grains; *m*, a pollen tube which has reached and entered the micropyle of the ovule; *n*, funicle of ovule; *o*, its base; *p*, outer integument; *q*, inner integument; *s*, nucellus of ovule; *t*, cavity of the embryo sac; *u*, its basal portion with antipodal cells; *v*, synergids; *w*, oösphere.

326. Course of the Pollen Tube.

—The time taken for the tube to penetrate to the ovary varies in different flowers according to the distance traversed and the rate of growth. In the crocus it takes from one to three days, in the spotted calla (*Arum maculatum*), about five days, and in orchids, from ten to thirty days. In the hibiscus and many others of the mallow family, we know that it can not well exceed twenty-four hours, as the corolla usually falls away on the evening of the day on which it expanded, carrying the



444.—A pollen grain emitting a tube (magnified).

style and stamens with it, so that if the pollen tube had not reached the ovary by that time it could never get there at all. Sometimes the pistil is hollow, affording a free passage to the pollen tube; in other cases it is solid and the growing tube eats its way down, as it were, feeding upon the substance of the pistil as it grows. How is it in the flower you are examining? In some orchids the pollen tubes can be seen by the unaided eye, massed together within the thickened style, looking like a strand of fine white floss. It takes a grain of pollen to fertilize

each ovule, and where more than one seed is produced to a carpel, as is commonly the case, at least as many pollen tubes must find their way to each cell of the ovary as there are ovules — provided all are fertilized.

327. Formation of the Seed. — When a pollen tube has penetrated to the ovary it next enters one of the ovules, usually through the micropyle (Fig. 443, *m*). There it penetrates the wall of a baglike inclosure called the embryo sac (Fig. 443, *u, t, z*), where a series of changes takes place too intricate to be described here, by which a fusion is brought about between a portion of the contents of certain cells emitted by the pollen tube and a large cell contained in the embryo sac, known as the germ cell, or egg cell (Fig. 443, *z*). The fusion of these two bodies is what constitutes fertilization. The cell formed by their union finally develops into the embryo and the other contents of the sac into the endosperm, and the ripened ovules become the seeds.

328. Stability of the Process of Fertilization. — The processes of fertilization and reproduction are very obscure and difficult to understand without a degree of skill in the manipulation of the microscope and a knowledge of technical details that the ordinary observer can seldom acquire. The phenomena that characterize them, however, are the most uniform and stable of all the life processes, varying little not only in different species and orders, but throughout the whole vegetable kingdom. For this reason they furnish a more reliable standard for judging of the real affinities of plants than mere external resemblances, which are more liable to variation and may often be accidental, and so they have been chosen by botanists as the ultimate basis for the classification of plants.

329. Embryology. — The study of the developing ovule, known as embryology, is a comparatively recent branch of science, and has resulted in overturning many of the ideas of the older botanists and the abandonment of many of the

established terms, which would now be misleading because they were founded upon false assumptions. This has led to a most unfortunate confusion in botanical terminology, the compensation for which lies in the hope that as investigation brings new truths to light greater clearness and certainty will grow out of the temporary disorder.

FIELD WORK

Look for examples of transition from one organ to another. These are particularly apt to occur in the so-called double flowers of the garden, and in those generally that have any of their organs indefinitely multiplied. Examine bracts and bud scales of different kinds, the carpellary leaves of leaflike follicles, such as those of the Japan varnish tree, milkweeds, columbine, and all sorts of vegetable monstrosities, which will generally be found to result from transformations of some sort. Study the numerical plan of some of the commonest flowers of your neighborhood; note the arrangement and consolidation of their organs, and determine their relative place in the evolutionary scale.

Make a list of all the outdoor plants, both wild and cultivated, that are found blooming in your neighborhood, keeping a record of the earliest specimens of each as you find them. The best way is to keep a sort of daily calendar, and at the end of each month give a summary of all the species found in bloom during that period. In this way a fairly complete annual record of the flowering time of the different plants for that vicinity will be obtained. The record should be kept up the whole year round. Don't stop in winter, but go straight on through the coldest as well as the hottest season, and you will make some surprising discoveries, especially if the record is kept up year after year. Give the common name of each plant, adding the botanical one if you know it. Any facts that you may know or may discover in regard to particular plants, such as their medicinal or other uses, their poisonous or edible properties, the insects that visit them, and in the case of weeds, their origin and introduction, will greatly enhance the interest and value of the record.

POLLINATION

MATERIAL. — This subject must be studied in the field and garden; no special directions for seeking material are needed.

330. Prevention of Self-Pollination. — The most interesting chapter in the history of plant life is that relating to the conveyance of pollen from the anther to the stigma.

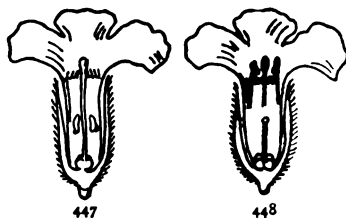
It was recognized by the older botanists that this transfer was necessary to the production of fruit, but they were puzzled for nearly two hundred years by the fact that many flowers seem to be constructed as if on purpose to defeat this object. In our examination of the iris, for instance, it was seen that the anthers lie under the broad



445, 446. — Flower of fireweed (*Epilobium angustifolium*) (GRAY): 445, with mature stamens and immature pistil; 446, the same a few days older, with expanded pistil after the anthers have shed their pollen.

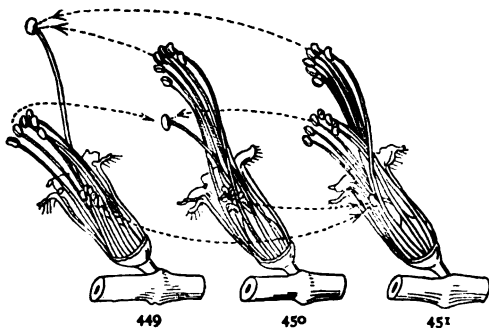
divisions of the style in such a manner that the pollen from them can not possibly reach the stigma without external agency; and in all monœcious and diœcious plants, self-pollination is clearly impossible. In other cases, of which the cone flower (*Rudbeckia*) and the common sage furnish examples, the anthers and stigma in the same flower do not mature together, thus producing the same effect as if they were unisexual.

331. Dimorphism is an expression for denoting a condition in which the stamens and pistils are of different relative lengths in different flowers of the same species, the stamens being long and the pistils short in some, the pistils long and the stamens short in others. Flowers of this sort are said to be dimorphous, or dimorphic, that is, of two forms; and some species are even *trimorphic*, having the two sets of organs long, short, and medium, respectively, in different indi-



447, 448. — Flower of pulmonaria:
447, long styled; 448, short styled.

viduals. Examples of dimorphic flowers are the pretty little bluets (*Houstonia cærulea*), the partridge berry (*Mitchella repens*), the swamp loosestrife (*Lythrum lineare*),



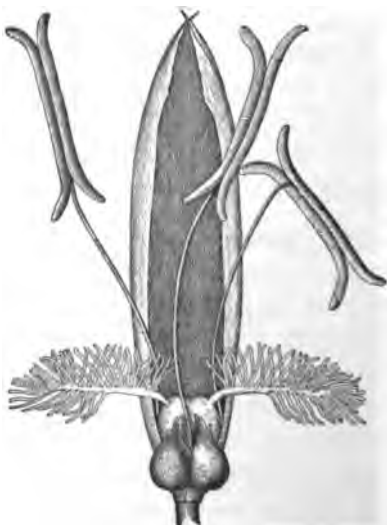
449-451. — Three forms of *Lythrum salicaria*.

and the English cowslip. Of trimorphic flowers we have examples in the wood sorrel, and the spiked loosestrife (*Lythrum salicaria*) of the gardens. These flowers were a great puzzle to

botanists until the celebrated naturalist, Charles Darwin, proved by a series of careful experiments that the seed produced by pollinating a dimorphous flower with its own pollen, or with pollen from a flower of similar form, are of very inferior quality to those produced by impregnating a long-styled flower with pollen from a short-styled one, and *vice versa*.

332. Wind Pollination.

— But the problem is only half solved when a plant has been rendered incapable of impregnating itself. Cross-pollination, that is, the transfer of pollen from a separate flower or plant, has been rendered necessary, and provision must now be made for the transportation. In many cases, of which the



452. — Feathery stigmas of a grass adapted to wind pollination.

pine, Indian corn, oaks, ragweed, and grasses of all sorts afford abundant examples, this is accomplished by the wind. This is a very clumsy and wasteful method, however, for so much pollen is lost by the haphazard mode of distribution that the plant is forced to spend its energies in producing a vast amount more than is actually needed, and great masses of it are frequently seen in spring floating like patches of sulphur on ponds and streams in the neighborhood of pine thickets. Wind-pollinated flowers are called by botanists *anemophilous*, a word meaning "wind-loving." Like those that are self-pollinated, they are generally very inconspicuous, devoid of odor and of all attractions of form or color, because they have no need of these allurements to attract the visits of insects.

333. Insect Pollination. — A more economical method of securing pollination is through the agency of insects. In probing around for the nectar or the pollen upon which they feed, these busy little creatures get themselves dusted with the fertilizing powder, which they unconsciously convey from the stamen of one flower to the pistil of another. Insects usually confine themselves, as far as possible, to the same species during their day's work, and since less pollen is wasted in this way than would be done by the wind, it is clearly to the advantage of a plant to attract such visitors, even at the expense of a little honey, or of a liberal toll out of the pollen they distribute.

Flowers that have adapted themselves to insect pollination are said to be *entomophilous*, insect lovers, and all their various attractions of form, color, and odor have been developed, not for the gratification of man, as human arrogance and self-conceit have so long asserted, but as notifications to their insect guests that the banquet of nectar is spread.

334. Special Partnerships. — Some plants have adapted themselves to the visits of one particular kind of insect so completely that they would die out if that species were to become extinct. The well-known alliance between red

clover and the bumblebee was brought to light a few years ago when the plant was first introduced into Australia. It grew luxuriantly and blossomed profusely, but would never set seed till the bumblebee was introduced to keep it company.



453.—Pod of *yucca angustifolia* pierced by the *Pronuba yuccasella*.

The most remarkable of these partnerships, perhaps, yet observed by naturalists, is that which exists between the little *pronuba*, or yucca moth, and the flowering yuccas, of which the bear's grass and Spanish bay-



454.—Moth resting on yucca blossom.



455.—*Pronuba* pollinating pistil of yucca.

onet of our old fields and roadsides are familiar examples. If any of these plants grow in your neighborhood, examine the pods and observe that none of them are perfect, but all show a constriction at or near the middle, such as is sometimes seen in the sides of wormy plums and pears. This is caused by the larvæ of the moth, which feed upon the unripe seeds. If you will look under the nodding perianth of a yucca blossom (Fig. 454), you will see that the short stamens are curved back from the pistil in such a manner that under ordinary circumstances, not a grain of the pollen can fall upon it except by the rarest accident. But the yucca moth is a good farmer as well as a provident mother, and as soon as she has deposited her eggs in the seed vessel, takes care to provide a crop of food for her offspring by gathering a ball of pollen in her antennæ and deliberately plastering it over the stigma (Fig. 455). In this way she insures the perfecting of the

fruit and the proper nourishment of her children. When the eggs are hatched the larvæ feed upon the unripe seeds for a time, but it is rare that more than a dozen or two are destroyed in a pod, so that, after all, the plant pays only a moderate commission for the service rendered.

An equally interesting partnership exists between the Smyrna fig and the little insect, *Blastophaga*, an account of which may be found in the Year Book of the Department of Agriculture for 1900. In these cases the mutual dependence is so complete that neither the plant nor the animal could exist without the other.

335. Protective Adaptations. — Where plants have adapted themselves to insect pollination it is, of course, important to shut out intruders that would not make good carriers. In general, small, creeping things like ants and plant lice are not so efficient pollen bearers as winged insects, and hence the various devices, such as hairs, sticky glands, scales, and constrictions at the throat of the corolla, by means of which their access to the pollen is prohibited. To this class of adaptations belong the hairy filaments of the spiderwort, the sticky ring about the peduncles of the catchfly, the swollen lips of the snapdragon, the scales or hairs in the throat of the hound's-tongue, the velvet petals of the partridge berry, etc.

Of flowers that are pollinated by night moths, some close during the day, as the four-o'clock and the evening primrose; and *vice versa*, the morning-glory, dandelion, and



456, 457. — Protection of pollen in the thistle: 456, position at night or in wet weather; 457, position in sunshine.

day flower (*Commelina*), unfold their beauties only to the sun. For similar reasons, night-blooming flowers are generally white or very light colored, and shed their fra-

grance only after sunset. A nodding position is assumed by many flowers at night or during a shower to keep the pollen from being injured by rain and dew.



458, 459. — A bell flower: 458, position in daylight; 459, position at night, or during wet weather.

336. Fraud and Robbery. — The secretion of honey by flowers is a very common means of attracting insect visitors. In general, plants that have very long, tubular corollas, like the trumpet honeysuckle (*Lonicera sempervirens*), and trumpet vine, are reserving their sweets for humming birds and long-tongued moths and butterflies. *Acleisanthes*, a plant of the four-o'clock family that grows along our Mexican border (Fig. 460), has a tube from twelve to fourteen centimeters long (about five and one half inches). Yet even deeper corollas than this can be explored by a humming bird of South America, which has a bill that sometimes reaches the length of fifteen centimeters (about six inches), and a tongue that can be protruded nearly as far again (Fig. 461). It is not uncommon, however, to find



460. — Tubular blossom of *Acleisanthes longiflora*.

such corollas with a hole in the tube near the base, made by thieving bees and wasps which thus get at the honey surreptitiously, without paying their tribute of pollen. On the other hand, plants like the carrion flower, and skunk cabbage seem to practice a kind of fraud upon flesh flies by imitating the colors and odors of the garbage upon which such creatures feed.



461.—Head and bill of sword bird
(*Docimastes ensiferus*).

337. Experiments.—An instructive experiment may be made with regard to the color preferences of insects by putting a drop or two of syrup on bits of glass and laying them on paper of different colors in the neighborhood of a beehive or other place frequented by insects, and observing which color seems to attract them most. Similar experiments may be made with perfumes and flavorings.

338. Color, being a very variable and unstable quality, is of little use in classifying flowers, yet it is interesting to know that all their endless variations of hue are confined approximately within certain limits. Nobody has ever seen a blue rose or a yellow aster, and though the florist's art is constantly narrowing the application of this law, it still remains true that in a state of nature certain colors seem to be associated together in the floral art gamut. Yellow is considered by botanists the simplest and most primitive color in flowers, and blue the latest and most highly evolved. Yellow, white, and purple, in the order named, are the commonest flower colors in nature; blue the rarest.

PRACTICAL QUESTIONS

1. Why do the flowers of oak, willow, and other wind-fertilized plants generally appear before the leaves? (332.)
2. Can you account for the "showers of sulphur" frequently reported in the newspapers? (332.)
3. Do you see any connection between the feathery stigmas of most grasses and their mode of pollination? (332.)

4. Why are wind-fertilized plants generally trees or tall herbs?
5. If March winds should cease to blow, would vegetation be affected in any way?
6. Can you trace any connection between the winds and the corn crop?
7. Is it good husbandry to plant different varieties of corn, or other grain in the same field?
8. Why do the seeds of fruit trees so seldom produce offspring true to the stock? (333.)
9. Would you place a beehive near a field of buckwheat? Of clover? Near a strawberry bed? In a peach orchard? Near a fig tree? Under a grape arbor?
10. Why are very conspicuous flowers like the camellia, hollyhock, and pelargoniums so frequently without odor?
11. Why is the wallflower "sweetest by night"? (335.)
12. What advantage can flowers like the morning-glory gain by their early closing? (335.)
13. Of what use to the cotton plant, Japan honeysuckle, and hibiscus is the change of color their blossoms undergo a few hours after opening? (335.)
14. Why does the Japan honeysuckle, that has run wild so abundantly in many parts of our country, produce so few berries?
15. If the trumpet vine grows in your neighborhood, examine a number of corollas and account for the dead ants found in them. Try to account also for the large hole (sometimes three quarters of an inch in diameter) often found near the base of the tube. (336.)
16. Do you see any connection between the greater freshness and beauty of flowers early in the morning and the activity of bees, birds, and butterflies at that time?
17. The flowers most frequented by humming birds are the trumpet honeysuckle, cardinal flower, trumpet vine, horse mint (*Monarda*), wild columbine, canna, fuschia, etc.; what inference would you draw from this as to their color preferences?

FIELD WORK

The subject is itself so suggestive that it is hardly necessary to do more here than append a list of some of the plants which it would be interesting to examine with reference to their mode of pollination.

The orchids present the most wonderful adaptations for insect pollination, of all the vegetable kingdom, but they are rare and difficult to be obtained, so it is better to look for specimens nearer home. In neighborhoods where the pogonia, the purple and yellow fringed orchis, or the moccasin flower (*Cypripedium*) are found, they should, of course, receive attention. Some more easily obtainable specimens are:

Wallflower	Cheiranthus Cheiri.
Bouncing Bet	Saponaria officinalis.
Columbine	Aquilegia vulgaris.
Monkshood	Aconitum Napellus.
Larkspur	Delphinium (various species).
Barberry	Berberis vulgaris.
Mignonette	Reseda odorata.
Pansy	Viola tricolor.
Syrian Hibiscus	H. Syriacus.
Cotton	Gossypium (various kinds).
Nasturtium	Tropæolum majus.
Touch-me-not	Impatiens (various species).
Wood sorrel	Oxalis (various species).
Horse-chestnut	Æsculus Hippocastanum.
Buckeye	Æsculus Pavia, flava, parviflora.
Pea	Pisum (various species).
Bean	Phaseolus (various species).
Ground nut	Apios tuberosa.
Vetch	Vicia.
Wistaria	Wistaria.
Black locust	Robinia Pseudacacia.
Clover	Trifolium (various species).
Apple, pear	Pyrus.
Peach	Prunus Persica.
Loosestrife	Lythrum Salicaria.
Maypop	Passiflora incarnata.
Gourds, squashes, etc. . . .	Cucurbitaceæ (various kinds).
Trumpet honeysuckle	Lonicera sempervirens.
Japan honeysuckle	Lonicera Japonica.
Partridge berry	Mitchella repens.
Cone flower	Rudbeckia.
Dandelion	Taraxacum officinale.
Ox-eye daisy	Chrysanthemum Leucanthemum.
Bell flower	Campanula rapunculoides.
Mountain laurel	Kalmia latifolia.
Andromeda	A. ligustrina.
Primrose	Primula officinalis, P. grandiflora
Persimmon	Diospyros Virginiana.
Lilac	Syringa vulgaris.
Periwinkle	Vinca major, V. minor.
Milkweed	Asclepias (various species).
Snapdragon	Antirrhinum majus.
Lousewort	Pedicularis Canadensis.
Trumpet vine	Tecoma radicans.
Horse balm	Collinsonia Canadensis.

Dead nettle	<i>Lamium amplexicaule</i> , L. album.
Sage	<i>Salvia officinalis</i> and other species.
Catmint	<i>Nepeta Cataria</i> .
Iris	<i>Iris</i> (various kinds).
Carrión flower	<i>Smilax herbacea</i> .
Bear's grass	<i>Yucca filamentosa</i> .
Spanish bayonet	<i>Yucca aloifolia</i> .
Lily of the valley	<i>Convallaria majalis</i> .
Day lily	<i>Hemerocallis fulva</i> .

PRACTICAL EXPERIMENTS

Experiments should be made by enveloping buds of various kinds in gauze, so as to exclude the visits of insects, and noting the effect upon the production of fruit and seed. Envelop a cluster of milkweed blossoms in this way and notice how much longer the flowers so protected continue in bloom than the others; why is this? Try the same experiment upon the blooms of cotton and hibiscus if you live where they grow, and see whether the characteristic change in color occurs in flowers from which insects have been excluded and whether good seed pods are produced by them. Try the effect upon fruit production of excluding insects from clusters of apple, pear, and peach blossoms.

IX. ECOLOGY

ECOLOGICAL FACTORS

339. Definition. — By ecology is meant the relations of plants to their surroundings. These may be classed under three general heads: their relations to inanimate nature, to other plants, and to animals. The subject has been touched upon repeatedly in the foregoing pages, and, in fact, it is impossible to treat of any branch of botany without some reference to it. All that was said about the adjustment of leaves for light and moisture, and their adaptations for protection and food storage, the devices for fruit and seed dispersal, etc., really belong to ecology, while Sections 330–338, about pollination, may be regarded as a very imperfect review of the ecology of the flower in relation to the insect world.

340. Symbiosis. — Associations for mutual help, like those described in Sections 330–338, between certain plants and their insect visitants, have been included by botanists under the general term, *symbiosis*, a word which means “living together.” In its broadest sense symbiosis refers to any sort of dependence or intimate organic relation between different kinds of individuals, and so may include the climbing and parasitic habits; but it is more properly restricted to cases where the relation is one of mutual benefit. It may exist either between plants of one kind with another, between animals with animals, or between plants and animals, as in the case of the clover and bumblebee, and the yucca and pronuba.

The occurrence of the root tubercles on certain of the leguminosæ (Sec. 198) is a clear case of symbiosis, the microscopic organisms in the tubercles getting their food

from the plant and at the same time enabling it to get food for itself from the air in a way that it could not otherwise do.

341. Relations with Inanimate Nature. — But it is to the relations of plants with inanimate nature, and their grouping into societies under the influence of such conditions, that the term "ecology" is more strictly applied. The external conditions that lead to the grouping are called *ecological factors*. The most important of these are temperature, moisture, soil, light, and air, including the direction and character of the prevailing winds. Each of these factors is complicated with the others and with conditions of its own in a way that often makes it difficult to determine just what effect any one of them may have in the formation of a given plant society.

342. Temperature, for instance, may be even and steady like that of most oceanic regions, or it may be subject to sudden caprices and variations like the "heated terms" and "cold snaps" that afflict our northern and southern States respectively every few years. We must remember, too, that it is not the average temperature of a climate but its extremes, especially of cold, that limit the character of vegetation.

Temperature probably has more influence than any other factor in the distribution of plants over the globe, but it can have little or no effect in evolving local differences in vegetation because the temperature of any given locality, except on the sides of high mountains, will ordinarily be practically the same within a circuit of many miles.

343. Moisture, again, may be of all degrees, from the superabundance of lakes and rivers and standing swamps, to the arid dryness of the desert, and the water may be still and sluggish, or in rapid motion. It may exist more or less permanently in the atmosphere, as in moist climates like those of England and Ireland, where vegetation is characterized by great verdure, or it may come irregularly

in the form of sudden floods, or at fixed intervals, causing an alternation of wet and dry seasons. Moreover, the moisture of the soil or the atmosphere may be impregnated with minerals or gases which may affect the vegetation independently of the actual amount of water absorbed.

344. Light may be of all degrees of intensity, from the blazing sun of the treeless plain to the darkness of caves and cellars where nothing but mold and slime can exist. Between these extremes are numberless intermediate stages; the dark ravines on the northern side of mountains; the dense shade of beech and hemlock forests; the light, lacy shadows of the pines; each characterized by its peculiar form of vegetation. Absence of light, too, is usually accompanied by a lowering of temperature and reduction of transpiration, factors which tend to accentuate the difference between sun plants and shade plants, giving to the latter some of the characteristics of aquatic vegetation. Generally, the tissues of these are thin and delicate, and having no need to guard against excessive transpiration they wither rapidly when broken.

345. Winds affect vegetation not only as to the manner of seed distribution, as in the case of tumbleweeds and winged fruits, but directly by increasing transpiration, and necessitating the development of strong holdfasts in plants growing upon mountain



463.—A red cedar grown in a barren, wind-beaten situation.



462.—A red cedar grown under normal conditions.

sides and in other exposed situations. The nature of the region from which they blow — whether moist, dry, hot, cold, etc., is also an important factor. In a district open to sea breezes, live oaks, which require

a salt atmosphere, may sometimes be found as far as a hundred miles from the coast.

346. Soil is perhaps the most interesting of these factors to the farmer, because it is the one that he has it most largely in his power to modify. It is to be viewed under two aspects: first, as to its mechanical properties, whether soft, hard, compact, porous, light, heavy, etc.; secondly, as to its chemical composition and the amount of plant food contained in it. The first can be regulated by tillage and drainage, the second by a proper use of fertilizers.

Under mechanical structure is included also the power of absorbing and retaining water. A good absorbent soil, *i.e.* sand, or gravel, is not apt to be a good retainer, while clay and marl, that absorb slowly, retain well.

347. Experiment. — Take a few handfuls of each of the different kinds of soil in your neighborhood, free them as thoroughly as possible from all traces of vegetation, place separately in small earthen pots or saucers and keep them well moistened. Pull up the seedling plants that appear in each, and keep a list of them as long as any continue to come up. What inference would you draw from the number produced in each pot as to the productiveness of the different soils? Could all the seedlings have lived if they had been left to grow where they came up? What becomes of the majority of seedlings that germinate in a state of nature?

PRACTICAL QUESTIONS

1. Is the relation between man and the plants cultivated by him a symbiosis?
2. Why is it that plants of the same, or closely related species, are found in such different localities as the shores of Lake Superior, the top of Mt. Washington, and the Black Mountains in North Carolina? (342.)
3. Which of the five ecological factors described in Sections 341-346 has probably influenced their distribution? (342.)
4. What is the prevailing character of the soil in your neighborhood?
5. Is your climate moist or dry? Warm or cold?
6. Can you trace any connection between these factors and the prevailing types of vegetation?

PLANT SOCIETIES

MATERIAL. — A specimen of pipewort (*Eriocaulon*), *Sagittaria*, pondweed, or other succulent water plant, and a cactus of some kind. The common prickly pear (*Opuntia*) is the one used in the text. City schools should have a small aquarium; a few water plants can be kept in jars.

348. Principles of Subdivision. — Plants group themselves into societies not according to their botanical relationships, but with regard to the predominance of one or more of the ecological factors that influence their growth. Sometimes one or two species will take practical possession of large areas, like the coarse grasses that spread over certain salt marshes, or the pines that formerly constituted the sole forest growth over extensive regions in North Carolina and Maine. But more usually we shall find a great diversity of forms brought together by their common requirements as to shade, soil, moisture, etc. These societies are, of course, purely artificial, and any of the factors named in Sections 341–346, or others of a different kind, may be made the basis of their classification. They might be grouped, for instance, according to the soil in which they grow, or according to origin, whether cultivated, wild, native, introduced, etc., as best suited the purpose of the classification in each case. The moisture factor, however, has been generally agreed upon by botanists as the one most convenient for ordinary purposes. Upon this principle plants are divided into three great groups:—

Hydrophytes, or water plants, those that require abundant moisture.

Xerophytes, or drought plants, those that have adapted themselves to desert or arid conditions.

Mesophytes, plants that live in conditions intermediate between excessive drought and excessive moisture. To this class belong most of our ordinary cultivated plants and the greater part of the vegetation of the globe.

Halophytes, "salt plants," is a term used to designate a fourth class, based not directly upon the water factor, but upon the presence of a particular mineral in the water or the soil, which they can tolerate. They seem to bear a sort of double relation to hydrophytes on the one hand and to xerophytes on the other.

349. Hydrophyte Societies. — These embrace a number of forms, from those inhabiting swamps and wet moors to the submerged vegetation of lakes and rivers. An exami-



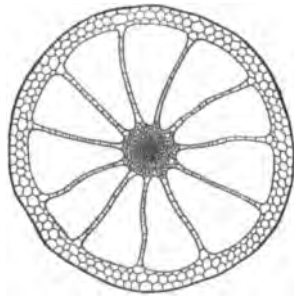
464. — A hydrophyte society of floating pondweed.



465. — A water plant (*Sagittaria natans*), showing the slender, ribbonlike, submerged leaves, the broad, rounded, floating ones, and the very slightly developed root system.

nation of almost any kind of water plant will show some of the physiological effects of unlimited moisture. Take a piece of pondweed, or other immersed plant out of the water and notice how completely it collapses. This is because, being buoyed up by the water, it has no need to spend its energies in developing woody tissue. Floating and swimming plants will generally be found to have no root system, or only very small ones,

because they absorb their nourishment through all parts of the epidermis directly from the medium in which they live. That they may absorb readily, the tissues are apt to be soft and succulent and the walls of the cells composing them very thin. In some of the pipeworts (*Eriocaulons*), the cells are so large as to be easily seen with the unaided eye. If you can obtain one of these, examine it with a lens and notice how very thin the walls are. Water plants also contain numerous air cavities, and often develop bladders and floats, as in the common bladderwort, and many seaweeds (Fig. 467).



466. — Transverse section through the stem of a hydrophyte plant (*Elatine alsinastrum*), showing the very large air cavities (GOODALE, after REINKE).

Swamp plants, drawing their nourishment from the loose soil in which they are anchored, and lacking the support of a liquid medium, develop roots and vascular stems. The roots



467. — Seaweed (*sargassum*) with bladderlike floats.



468. — A cypress trunk, showing enlarged base for aëration.

of plants growing in swamps have difficulty in obtaining proper aëration on account of the water, which shuts off the air from them, hence they are furnished with large

air cavities, and the bases of the stems are often greatly enlarged, as in the Ogeechee lime (*Nyssa capitata*) and cypress, to give room for the formation of air passages. The peculiar hollow projections known as "cypress knees" are arrangements for aërating the roots of these trees.

350. Xerophyte Societies are adapted to conditions the reverse of those affected by hydrophytes. The extreme of these conditions is presented by regions of perennial drought like our western arid plains and the great deserts of the interior of Asia and Africa. Under these conditions



469. — "Switch plants" of the alkali desert, condensed into mere green skeletons of vegetation, and thus adapted to extreme xerophyte conditions.

plants have two problems to solve; to collect all the moisture they can and to keep it as long as they can. Hence, plants of such regions diminish their evaporating surface by reducing or getting rid of their foliage and compacting all their tissues into the stem, like the cactus (Sec. 209), or they compress their leaves into thick and fleshy forms fitted to resist evaporation and retain large amounts of moisture, as in the case of the yucca and century plant. They also frequently develop a thick, hard epidermis, or cover themselves with protective hairs and scales.

351. Examination of a Xerophytic Plant. — Examine a joint of the common prickly pear (*Opuntia*), if it grows in your neighborhood, or use a potted cactus, and give your reasons for regarding it as a stem and not as a leaf.

Notice how the spines are arranged on the surface, and if there are any fruits, buds, or flowers, where they occur. Peel off a little of the epidermis and observe its thick, horny texture. Cut a cross section through a joint about midway from base to apex and examine with a lens. Notice the thick layer of green tissue next the epidermis, and within that, a band of tough, woody fibers inclosing the soft pulpy mass that makes up the interior. (If the woody layer is not easily made out, allow your specimen to dry for about twenty-four hours, and it will become quite distinct.) Make a longitudinal section through the center of a joint and trace the course of the woody fibers; do they get any more abundant toward the base? Do any of them pass into the spine clusters? What do the spines represent? What is the use of the green layer just under the epidermis? Why is it so much more abundant in the cactus than in ordinary stems? Lay aside a section of a cactus plant, or a leaf of yucca, agave, or other fleshy xerophyte to dry and see how long it takes to lose its moisture. What would you conclude from this as to its retentive power?



470. — A plant of *Opuntia*, showing young branches and flowers from the nodes.

352. Other Xerophyte Adaptations. — Plants exposed to periodic and occasional droughts frequently provide against hard times by laying up stores of nourishment in bulbs and rootstocks and retiring underground until the stress is over. This is known to botanists as the *geophilous*, or earth-loving habit. Others, as some of the lichens, and the little resurrection fern (*Polypodium incanum*), so common on the trunks of oaks and elms, make no resistance, but wither away completely during dry weather, only to waken again to vigorous life with the first shower.



471, 472. — A resurrection fern : 471, in dry weather ; 472, after a shower.

353. Mesophytes. — These embrace the great body of plants growing under ordinary conditions, which may vary from the liberal moisture of low meadows and shady forests

to the almost xerophytic barrenness of dusty lanes and gullied hillsides. The forms and conditions they present are so diversified that it will be impossible even to touch upon them all in a work like this, but they may be summed up under the two principal heads of open ground and woodland growth. Under the first are included all cultivated grounds; fields, lawns, meadows, pastures, and roadsides, with their characteristic weeds, flowers, and grasses. Under the second, all woods and copses with the shrubs and herbs that form their undergrowth.

354. Halophytes include plants growing by the seashore and the vegetation around salt springs and lakes and that of alkali deserts. Seaweeds are in a sense halophytes, since they live in salt water, but as they are true aquatic plants and exhibit many of the peculiarities of hydrophytes in their mechanical structure, they are classed with them. The name halophyte applies more particularly to land plants that have adapted themselves to the presence of certain minerals, popularly known as salts, in the soil or in the atmospheric vapor. If you have ever spent any time at the seashore, you can not fail to have been struck with the thick and fleshy habit exhibited by many of the plants growing there, such as the samphire, sea purslane (*Sesuvium*), and sea rocket (*Cakile*). A form of goldenrod found by the seashore has thick, fleshy leaves, and is as hard to dry as some of the fleshy xerophytes.

Another characteristic of desert plants that is common also to seaside vegetation, is the frequent occurrence of a thick, hard epidermis, as in the sea lavender and saw grass. The live oaks, trees that love the salt air and never flourish well beyond reach of the sea breezes, have small, thick, hard leaves, very like those of the stunted oaks that grow on the dry hills of California. The presence of spines and hairs, it will be observed, is also very common; *e.g.* the salsola, the sea ox-eye, and the low primrose (*Enothera humifusa*). In other cases the leaf blades are so strongly involute or revolute (Sec. 60)

as to make them appear cylindrical—an arrangement for protecting the stomata (Fig. 98) and preventing transpiration. All these, it will be observed, are xerophyte characteristics, and the object in both cases is the same—economy of moisture. The reason why such adaptations are necessary in halophyte plants is because the mixture of salt in the water of the soil increases its density so that it is difficult for the plant to absorb what it needs (Sec. 227). Hence, halophytes are in the condition of Coleridge's "Ancient Mariner"; with "water, water everywhere," they are practically living under xerophyte conditions.

PRACTICAL QUESTIONS

1. Why do florists always cultivate cactus plants in poor soil? (350.)
2. What would be the effect of copious watering and fertilizing on such a plant? (350.)
3. Why must an asparagus bed be sprinkled occasionally with salt? (348, 354.)
4. If a gardener wished to develop or increase a fleshy habit in a plant, to what conditions of soil and moisture would he subject it? (350, 354.)
5. What difference do you notice between blackberries and dewberries grown by the water and on a dry hillside?
6. Is there a corresponding difference between the root, stem, or leaves of plants growing in the two situations, and if so account for it?
7. When a tract of dry land is permanently overflowed by the building of a dam or levee, why does all the original vegetation die, or take on a very sickly appearance? (349.)
8. Should plants with densely hairy leaves be given much water, as a general thing? (68, 350.)
9. A farmer planted a grove of pecan trees on a high, dry hilltop; had he paid much attention to ecology?
10. Give a reason for your answer.

FIELD WORK

Ecology offers the most attractive subject for field work of all the departments of botany. It can be studied anywhere that a blade of vegetation is to be found. In riding along the railroad there is an endless fascination in watching the different plant societies succeed one

another and noting the variations that they undergo with every change of soil or climate.

Students in cities can study ecology in parks and public squares, in the vegetation that springs up on vacant lots, around doorsteps and area railings, and even between the paving stones of the more retired streets. A botanist found on a vacant lot near the public library in Boston over thirty different kinds of weeds and herbs, and in the heart of Washington, D.C., on a vacant space of about twelve by twenty feet, nineteen different species were counted. Even in great cities like London and New York, one occasionally recognizes among the rare weeds struggling for existence with the paving stones in out-of-the-way corners, some old acquaintance of fields and roadsides far away. Just where all these things came from, and how they got there, and why they stay there, will be interesting questions for city students to solve.

But the country always has been and always will be the happy hunting ground of the botanist. All the factors considered in the two preceding sections can hardly be found in any one locality, but mesophyte and hydrophyte conditions exist almost everywhere, and approximations to the xerophyte state can generally be found at some season in open, sandy, or rocky places, along the borders of dry, dusty roads, and on the sun-baked soil of old red hills and gullies.

If there are any bodies of water in your neighborhood (in cities, visit the artificial lakes in parks), examine their vegetation and see of what it consists. Notice the difference in the shape and size of floating and immersed leaves and account for it. Note the general absence of free-swimming plants in running water, and account for it. Note the difference between the swamp and border plants and those growing in the water, and what trees or shrubs grow in or near it. Compare the vegetation of different bogs and pools in your neighborhood, and account for any differences you may observe; why, for instance, does one contain mainly rushes, sedges, and cat-tails, another ferns and mosses, another sagittaria, boneset, water plantain, etc., and still another a mixture of all kinds? Compare the water plants with those growing in the dryest and barrenest places in your vicinity, note their differences of structure, and try to find out what special adaptations have taken place in each case.

Draw a map of some locality in your neighborhood that presents the greatest variety of conditions, representing the different ecological regions by different colored inks or crayons, or by different degrees of shading with the pencil.

X. SEEDLESS PLANTS

THEIR PLACE IN NATURE

355. Order of Development. — All the forms that have hitherto claimed our attention belong to the great division known as Spermatophytes, or seed-bearing plants, sometimes designated also as Phanerogams, or flowering plants. They comprise the higher forms of vegetable life, and because they are more striking and better known than the other groups, they have been taken up first, since it is easier for ordinary observers to work their way backwards from the familiar to the less known.

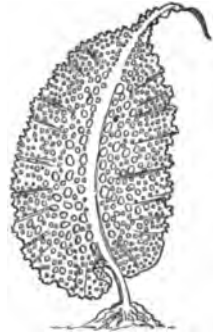
But it must be understood that this is not the order of nature. The geological record shows that the simplest forms of life were the first to appear and from these all the higher forms were gradually evolved. There is no sharp line of division between any of the orders and groups of plants, but the line of development can be traced through a succession of almost imperceptible changes from the lowest forms to the highest, and it is only by a study of the former that botanists have come to understand the true nature and structure of the latter.

It would be impossible, in a work like this, to attempt even a superficial view of the various divisions of seedless plants. Many of them are of microscopic size, and can not be studied without expensive laboratory appliances and skill in the manipulation of the microscope, which not everybody can possess. A short study of only a few typical forms will be attempted here, in order to make clearer some of the processes of plant life that have already been touched upon.

356. Classification. — Beginning with the lowest forms, seedless plants are grouped into three great orders, or classes.

357. I. Thallophytes, or thallus plants.

This group takes its name from the thallus structure that characterizes its vegetation. What a thallus is will be better understood after a specimen has been examined. It may be stated, however, that the term is applied in general to the simplest kinds of vegetable structure, in which there is no differentiation of tissues, and no true distinction of root, stem, and leaves. While it is not peculiar to the thallophytes, it has attained its most typical development among them, and the name is therefore retained as distinctive of that group. It embraces two great divisions, the Algæ and Fungi. The first includes seaweeds and the common fresh-water-brook silks, pond scums, etc., besides numerous microscopic forms whose presence escapes the eye altogether, or is made known only by the discolorations and other changes they effect in the water.



473. — A seaweed with broad expanded thallus.



474. — *Anthoceros*, a liverwort with flat, spreading thallus.

To the fungi belong the mushrooms and puff balls, the molds, rusts, mildews, etc., and the vast tribe of microscopic organisms called bacteria, that are so active in the production of fermentation, putrefaction, and disease.

358. II. Bryophytes, or moss plants.

This group likewise contains two divisions, mosses and liverworts. Familiar examples of the latter are the marchantia, or umbrella liverwort (Figs. 500, 502), commonly found on the ground in cool bogs, and the flat, spreading plants, bearing somewhat the aspect of lichens,



475.—*Scapania*, a liverwort with leafy thallus, approaching the form of mosses and lycopodiums (from COULTER'S "Plant Structures").



477.—A common fern (*Polypodium vulgare*).

except for their color, met with everywhere on wet rocks and banks around shady water courses.

Mosses are one of the best defined of botanical orders, and are too well known to need further specification here.

Bryophytes form a connecting link, or rather a chain of connecting links between the next group, pteridophytes, and thallophytes. The liverworts represent the more primitive division of the group, and in some of their forms approach so near the thallophytes that it does not take a botanist to recognize the relationship.

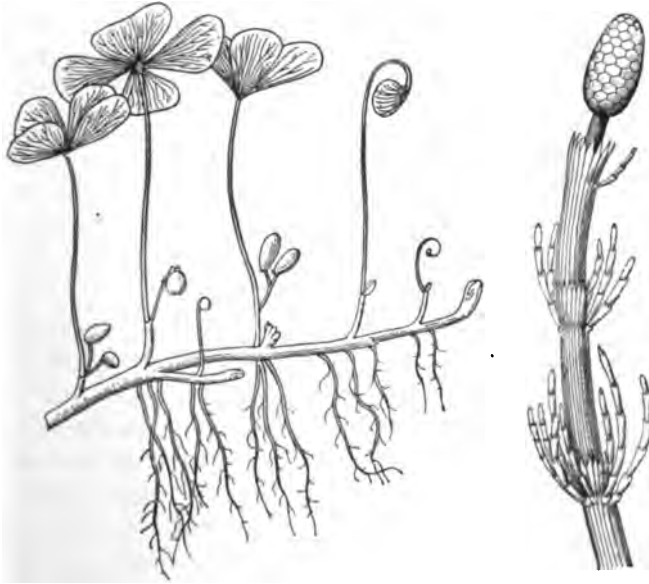
359. III. Pteridophytes, or fern plants, include the three divisions of ferns, horse-tails, and club mosses. They differ greatly in structure, but all possess a vascular system, a well-organized system of root, stem, and leaves, and rank next to the spermatophytes in the order of develop-



476.—A common moss plant, with parts apparently divided into root, stem, and leaves, but with no true differentiation of tissues (from COULTER'S "Plant Structures").

ment of root, stem, and leaves, and rank next to the spermatophytes in the order of develop-

ment. They are frequently distinguished as the vascular cryptogams to differentiate them from the other two groups, cryptogams being a term sometimes used to designate the three orders of seedless plants. The distinction



478. — A water pteridophyte, *Marsilea*
(after GRAY).

479. — Part of the fruiting
stem of a scouring rush,
Equisetum limosum (after
GRAY).

between vascular and non-vascular plants is relatively as important a one as that between vertebrates and invertebrates in the animal kingdom.

Just what these three great groups are, and what relation they bear to one another, will be better understood by the study of a typical specimen of each.

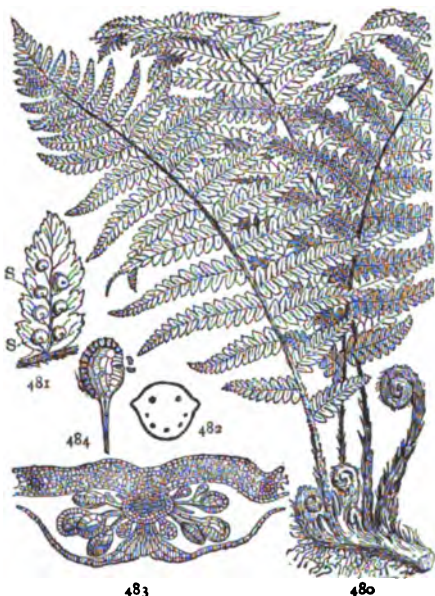
FERN PLANTS

MATERIAL. — Any kind of fern in the fruiting stage. The pretty little ebony fern (*Asplenium ebeneum*), and the Christmas fern (*Aspidium acrostichoides*) are common almost everywhere, the former on shady hillsides near the foot of rocks and stumps, or in the shadow of walls and fences; the latter in rocky woods and along water courses

almost everywhere. City schools can supply themselves with specimens by cultivating a few ornamental ferns in the schoolroom. While gathering specimens look along the ground under the fronds, or in greenhouses where ferns are cultivated, among the pots and on the floor, for a small, heart-shaped body like that represented in Figures 493, 494, called a *prothallium*. It is found only in very wet places and care must be taken in collecting specimens, as in their early stages the prothalli bear a strong resemblance to certain liverworts found in the same places. The best way is for each class to raise its own specimens by scattering the spores of a fern in a glass jar, on the bottom of which is a bed of moist sand or blotting paper. Cover the jar loosely with a sheet of glass and keep it moist and warm, and not in too bright a light. Spores of the sensitive ferns (*Onoclea*) will germinate in from two to ten days, according to the temperature. Those of the royal fern (*Osmunda*) germinate promptly if sown as soon as ripe, but if kept even for a few weeks are apt to lose their vitality. The spores of sensitive fern can be kept for six months or longer, while those of the bracken (*Pteris*) and various other species require a rest before germinating, so that in these cases it is better to use spores of the previous season.

360. Study of a Typical Fern.—Observe the size and general outline of the fronds, and note whether those of the same plant are all alike, or if they differ in any way, and how. Observe the shape and texture of the divisions or pinnæ composing the frond, their mode of attachment to the rachis, and whether they are simple, or notched or branched in any way. Make a sketch, labeling the primary branches of the frond, *pinnæ* (sing. *pinna*), the secondary ones, if any, *pinnules*, and the common stalk that supports them, *stipe*. Note the color, texture, and surface of the stipe. If any appendages are present, such as hairs, chaff, or scales, notice whether they are most abundant toward the apex or the foot of the stipe, or equally distributed over its whole length. Cut a cross section near the foot and look through your lens for the roundish or oblong dots that show where the fibrovascular bundles were cut through (Fig. 482). How many of them do you see? Make a sketch and compare with your sectional drawings of the stems of monocotyledons and dicotyledons; what differences do you notice? Which does it resemble most?

Examine the mode of attachment of the stipes to their underground axis. Break one away and examine the scar. Compare with your drawings of leaf scars and with Figure 274. Do the stipes grow from a root or a rhizoma? How do you know? Do you find any remains of leafstalks of previous years? How does the rootstock increase in length? Measure some of the internodes; how much did it increase each year? Cut a cross section and look for the ends of the fibrovascular bundles. Trace their course through several internodes. Do they run straight or do they turn or bend in any way at the nodes? If so, where do they go?



480-484. — A fern plant: 480, fronds and rootstock; 481, fertile pinna: *s, s*, sori; 482, cross section of a stipe, showing ends of the fibrovascular bundles; 483, a cluster of sporangia, magnified; 484, a single sporangium still more magnified, shedding its spores.

361. Veining. — Hold a pinna up to the light and examine the veining. Is it like any of the kinds described in Sections 37-40? This forked venation is a very general characteristic of the ferns. When the forks do not reticulate or intercross in any way, the veins are said to be free; are they free in your specimen, or reticulated?

362. Fructification. — Examine the back of the frond; what do you find there? (Most ferns bear many sterile fronds; care must be taken to secure some fruiting ones.) These dots are the *sori* (sing. *sorus*), or fruit clusters, and

the fronds or pinnæ bearing them are said to be *fertile*. Are there any differences of size, shape, etc., between the fertile and sterile fronds of your specimen? Between the fertile and sterile pinnæ? On what part of the frond are the fertile pinnæ



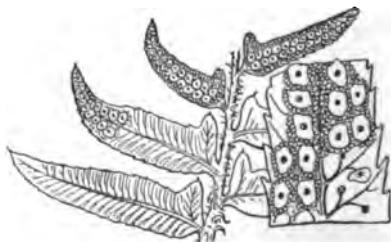
485. — Part of a fertile pinna of *polypodium* enlarged, showing the sori without indusium.



486. — Part of a pinna of *peilea* enlarged, showing indusium formed by the revolute margin.

borne? Notice the shape and position of the sori, and their relation to the veins, whether borne at the tips, in the forks, on the upper side (toward the margin) or the lower (toward the midrib). Look for a delicate membrane (*indusium*) covering the sori, and observe its shape and mode of attachment. (If the specimen under

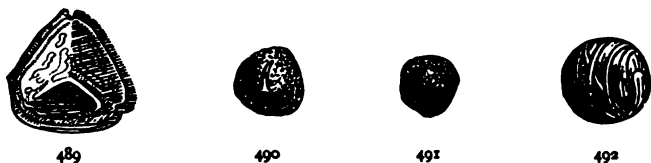
examination is a polypodium there will be no indusium; if a maidenhair (*Adiantum*), or a bracken (*Pteris*), it will be formed of the revolute margin of the pinna.) In lady fern (*Asplenium Filix-fœmina*), and Christmas fern (*Aspidium*), the sori frequently become confluent, that is, so close together as to appear like a solid mass. Sketch a fertile pinna as it appears under the lens, bringing out all the points noted.



487, 488. — Christmas fern (*Aspidium*): 487, part of a fertile frond, natural size; 488, a pinna enlarged, showing the sori confluent under the peltate indusia.

363. The Spore Cases. — Look under the indusium at the cluster of little stalked circular appendages (Fig. 483). These are the *sporangia*, or spore cases, in which the reproductive bodies are borne. Seen under the microscope each sporangium looks like a little stalked bladder surrounded by a jointed ring (Fig. 484). At maturity the

ring straightens itself out, ruptures the wall of the sporangium, and the spores are discharged with considerable



489-492. — Spores of pteridophytes, magnified: 489, a fern spore; 490, 491, two views of a spore of a club moss; 492, spore of a common horsetail (*Equisetum arvense*).

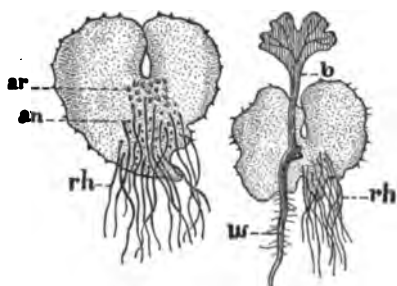
force. Compare the spores depicted in Figures 489-492, with the pollen grains in Figures 378-381. Do you notice any resemblance?

364. Reproduction. — The spores are the reproductive bodies of ferns, and correspond in this respect to the seeds of spermatophytes, but their mode of reproduction is very different, or rather seems so, because here the process known as *alternation of generations* first becomes apparent to the eye, as we proceed from the higher plants to the lower. The same thing occurs among seed plants also, but as it is there partly concealed within the seed, botanists first became acquainted with it through the study of spore-bearing plants, where it is more clearly revealed. What is meant by it will be better understood after the life history of the ferns has been studied.

365. The Sporophyte. — The spores found in such abundance on the fertile pinnæ are all alike, and each one is capable of germinating and continuing the work of reproduction without the necessity of any such union as we saw taking place between the pollen and the ovule in the spermatophytes. The plant or part of a plant that bears these reproductive bodies is called a *sporophyte*, or spore plant, and with its crop of spores makes up one generation.

366. The Prothallium. — When one of these spores germinates, it produces, not a fern plant like the one that bore it, but a small, heart-shaped body like that shown in

Figure 493, called a prothallium. Examine one of these bodies carefully with a lens. Observe that there are no veins nor fibrovascular bundles, and the whole body of the plant seems to consist of one uniform tissue. Some little rootlike hairs, called *rhizoids*, will be found growing on the under side, but these are shown by the microscope



493

494

493, 494. — Prothallium of a common fern (*Aspidium*): 493, under surface, showing rhizoids, *rh*, antheridia, *an*, and archegonia, *ar*; 494, under surface of an older gametophyte, showing rhizoids, *rh*, and young sporophyte, with root, *w*, and leaf, *b* (from COULTER'S "Plant Structures").

to be mere appendages of the epidermis in the nature of hairs, and not true roots. Such a body as this, in which there is no differentiation of parts, is what constitutes a thallus. It occurs in all kinds of plants under varying forms, and different names are given to it. In the ferns it is called a *prothallium*. In them it is generally short-

lived and is important only in connection with the work of reproduction. Note its heart-shaped outline, and look just below the deep notch at the apex for certain little bottle-shaped bodies called *archegonia*. (They will probably appear under the lens as mere dots, or may not be visible at all.) These correspond to the pistils of seed plants. Lower down, among the rhizoids, or near the margin of the prothallium, are certain organs, called *antheridia*, corresponding to the stamens of spermatophytes.

367. The Gametophyte. — The reproductive cells contained in the antheridia and archegonia are called *gametes* and from them the prothallium is called a *gametophyte*, or gamete plant, in contradistinction to the sporophyte or spore plant. The gametes differ from ordinary spores in not being able to perform the work of reproduction directly by germination, but a pair of them must first unite and form

another kind of spore called an *oöspore*, which is capable of germinating. It reproduces, however, not the simple thalluslike gametophyte from which it sprang, but the beautiful fern plant, or sporophyte, with its vascular system and complete outfit of vegetative organs—root, stem, and leaves.

368. Alternation of Generations.—We all know the meaning of the word generation as applied to the direct descendants of one organism from another, whether animal or plant. When two successive generations produce respectively ordinary spores and oöspores, and these different kinds of spores give rise to organisms unlike in structure or habits of life, there is said to be an alternation of generations. The generation which bears the simple spores (sporophyte) is said to be asexual; the one which produces the gametes and oöspores is sexual; that is, it requires the union of two separate bodies to produce a fertilized germ, or oöspore. Each generation, therefore, it will be observed, gives rise to its opposite, the asexual sporophyte producing the sexual gametophyte, or prothallium, and this in turn, through its gametes and oöspores reproducing the asexual sporophyte. The alternation in ferns may, in general, be expressed to the eye by a series of diagrams like those given below. The words in each line are synonyms of those immediately above or below them in the other lines, except it must be observed that, strictly speaking, it is not the antheridia and archegonia, but the spores or gametes contained in them that by their union produce the oöspore.

Fern plant → Spores → Prothallium → $\left\langle \begin{array}{c} \text{Archegonia} \\ \text{Antheridia} \end{array} \right\rangle \rightarrow \text{Oöspore} \rightarrow \text{Fern plant.}$

Sporophyte → Spores → Gametophyte → $\left\langle \begin{array}{c} \text{Gamete} \\ \text{Gamete} \end{array} \right\rangle \rightarrow \text{Oöspore} \rightarrow \text{Sporophyte.}$

Asexual gen. → Spores → Sexual gen. → $\left\langle \begin{array}{c} \text{Gamete} \\ \text{Gamete} \end{array} \right\rangle \rightarrow \text{Oöspores} \rightarrow \text{Asexual gen.}$

369. Advantages of Alternation.—This roundabout mode of reproduction would hardly have been developed

unless it had been of some benefit to the plants practicing it. The chief advantage seems to be in more rapid multiplication and consequently better chance to propagate the species. Only one plant is produced by each oöspore, and if this were a gametophyte with its limited number of archegonia, multiplication would be slow; but the sporophyte with its millions of spores, each capable of producing a new individual, enables the species to multiply indefinitely. On the other hand, the interposition of a gametophyte, or sexual generation, secures the introduc-



495-499.— A kind of pteridophyte (*Selaginella martensii*) with its organs of fructification: 495, a fruiting branch; 496, a microsporophyll with a microsporangium, showing microspores through a rupture in the wall; 497, a megasporophyll with a megasporangium; 498, megaspores; 499, microspores (from COULTER'S "Plant Structures").

tion of a new strain at each alternation, with the advantages of cross-fertilization (Sec. 312).

370. Microspores and Macrospores. — The method of reproduction in other pteridophytes is similar in all essentials to that of the ferns, except that in some of the orders it is even more complicated. The sporophyte, instead of producing spores which are all alike, bears two kinds of fruiting organs called *sporophylls* (spore-bearing leaves), one of which produces sporangia containing large bodies called *megaspores*, or *macrospores*, the other smaller ones called *microspores*. These large and small spores give rise to different kinds of gametophytes, one bearing archegonia, the other antheridia, and it is only by the union of a pair of gametes from each kind that an oöspore capable of producing another sporophyte can originate. This complicated arrangement may be expressed to the eye by a diagram something like the following, in which *S* stands for sporophyte, *G* for gametophyte, *mgs.* for megaspore, *mcs.* for microspore, *mgsph.* for megasporophyll, *mcsph.* for microsporophyll, *gam.* for gamete, and *oö.* for oöspore.

S. → $\left\langle \begin{array}{l} \text{mgsph.} \rightarrow \text{mgs.} \rightarrow \text{archegonial G.} \rightarrow \text{gam.} \\ \text{mcsph.} \rightarrow \text{mcs.} \rightarrow \text{antheridial G.} \rightarrow \text{gam.} \end{array} \right\rangle \rightarrow \text{oö.} \rightarrow \text{S., etc.}$

PRACTICAL QUESTIONS

1. Have ferns any economic use — that is, are they good for food, medicines, etc.?
2. What is their chief value?
3. Under what ecological conditions do they grow?
4. Are they often attacked by insects, or by blights and disease of any kind?
5. Of what advantage is it to ferns to have their stems under ground, in the form of rootstocks? (195.)
6. What causes the young frond of ferns to unroll? (162, 204.)
7. Name the ferns indigenous to your neighborhood.
8. Which of these are most ornamental, and to what peculiarities of structure do they owe that quality?
9. Are cultivated ferns usually raised from the spores or in some other way? Why?

STUDY OF A BRYOPHYTE

MATERIAL. — Any of the common thalloid or flat-bodied liverworts. They can generally be found growing with mosses on wet, dripping rocks and the shady banks of streams, and are easily recognized by their flat, spreading habit, which gives them the appearance of green lichens. *Marchantia polymorpha* (Fig. 500), one of the largest and best specimens for study, is common in shady, damp ground throughout the north-



500. — Umbrella liverwort (*Marchantia polymorpha*); portion of a thallus about natural size, showing dichotomous branching: *f, f*, archegonial or female receptacles; *r*, rhizoids.

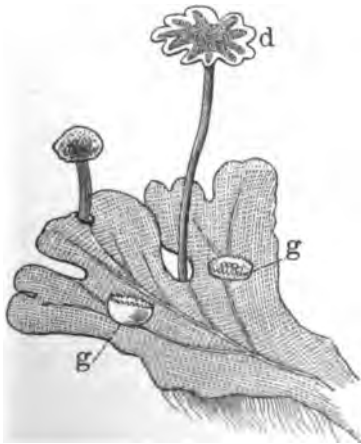
ern States. *Lunularia*, a smaller species that can be recognized by the little crescent-shaped receptacles on some of the divisions of the thallus, is abundant in greenhouses almost everywhere, on the floor, or on the sides of pots and boxes kept in damp places. Specimens of this can be procured by city classes, but the spore-bearing receptacles are seldom or never present, the species being an introduced one and possibly rendered sterile by changed conditions. *Marchantia polymorpha* is the specimen described in the text, but any allied species will do.

371. Examination of a Liverwort. — The Thallus. The broad, flat, branching organ that forms the body of the plant is the thallus. Examine the end of each branch; what do you find there? Are the two forks into which the apex of the branches divide equal or unequal? Do you see anything in these forking apices to remind you of the heart-shaped prothallium of the fern? Are there any other points of resemblance between them? Compare the growing end with the distal one; does it proceed from a true root? Notice that as the lower end dies the growing branches go on increasing and reproducing the thallus.



501. — Under side of an archegonial receptacle enlarged. The archegonia are borne among the hairs on the under surface, which is presented to view in the figure; *f*, a spore case.

Do you find anything like a midrib? If so, trace it along the branches and stem; where does it end? Does it seem to be formed like the midrib of a dicotyledon? Hold a piece of



502. — Portion of a thallus bearing an antheridial disk or receptacle, *d*, and gemmae, *g*, *g*.



503. — A portion of the upper epidermis of marchantia, magnified, showing rhomboidal plates with a stoma in each.

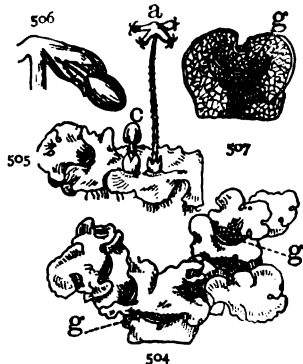
the thallus up to the light and see if you can detect any veins. Is it of the same color in all parts, and if there is a difference can you give a reason for it? Examine the upper surface with a lens. Peel off a piece of the epidermis, place it between

two moistened bits of glass and hold it up to the light, keeping the upper surface toward you; what is its appearance? Observe a tiny dot near the center of the rhomboidal areas into which the epidermis is divided and compare it with your drawings of stomata (Sec. 16). What should you judge that these dots are?

372. Rhizoids. — Wash the dirt from the under side of a thallus and examine with a lens; how does it differ from the upper surface? Observe the numerous rootlike hairs, or rhizoids. What is their color? Where do they spring from? These are not true roots, but hairs that have taken upon themselves the function of absorption, and do not imply any actual differentiation of tissues.

Plant a growing thallus branch in moist earth so that the upper side will lie next the soil and watch for a week or two, noting what changes take place. What would you

infer from this as to the cause of the difference between the two surfaces? Would rhizoids be of any use on the upper side? Stomata on the under side?



504-507. — *Lunularia*, a common liverwort: 504, portion of a thallus of about natural size; *g, g*, gemmæ; 505, a fertile plant with fruiting receptacles; 506, an enlarged section of one of the fruiting receptacles; 507, portion of a sterile thallus slightly enlarged, showing one of the crescent-shaped gemmæ from which the plant takes its name.

373. Gemmæ. — Look along the upper surface of some of your specimens for little saucer-shaped (in *Lunularia*, crescent-shaped) cupules or cavities. Notice the border, whether it is toothed or entire, and see if you can tell what the cupules contain. These little bodies, called *gemma*, are a kind of bud, by which the plant propagates itself somewhat as the onion and the tiger lily do by means of bulblets. Sow some of the gem-

mæ on moist sand, cover them with a tumbler to prevent evaporation, and watch them develop the thalloid structure.

374. Reproduction by Spores. — If possible, procure a thallus with upright pedicels bearing enlargements at the top like those represented in Figures 500 and 502. These are receptacles containing spore cases corresponding to the archegonia and antheridia of the fern prothallium. Notice their difference in form, the one (Fig. 502) umbrella shaped and scalloped round the edges, the other (Fig. 500) rayed, like the spokes of a wheel. The first produce antheridia only, and the second archegonia. Examine both surfaces of each, and then vertical sections, under a lens. Notice that the antheridia grow from the upper surface of the scalloped disks, the archegonia from the underside of the rayed ones, concealed in the heavy covercles that depend from the rays (Fig. 501). The archegonia and antheridia, as in the ferns, produce different kinds of reproductive cells called gametes, and so the thallus that forms the plant body of the liverwort is the gametophyte and corresponds to the prothallium of the fern. When one of the gametes from an antheridium enters an archegonium and fuses with the other kind of gamete contained there, an oöspore is formed as in the fern, which is capable of germinating and producing a new growth. But instead of falling to the ground and giving rise to an independent plant like the sporophyte of the fern, the oöspore germinates within the receptacle and produces there an insignificant spore case (*f*, Fig. 501), containing ordinary spores and thus representing in a reduced form the sporophyte that is so conspicuous a feature of the ferns. These spores, on germinating, produce the liverwort thallus body or gametophyte, thus completing the cycle of generations. Notice that in the liverwort (and all bryophytes), the thallus or gametophyte, is the important part of the plant and performs all the vegetative functions, while the sporophyte is a small, insignificant body that never becomes detached from the gametophyte and has no independent existence. In the fern and other pteridophytes just the reverse is true; the sporophyte constitutes the beautiful plant body that we all admire so much, while the gametophyte, though it does attain a

separate existence, appears only as an obscure prothallium that is usually as short lived as it is inconspicuous.

375. Alternation of Generations in Seed Plants. — While the alternation of generations is more conspicuous in pteridophytes and bryophytes, it occurs also among the algæ, and is universal, though in a masked form, among the spermatophytes. It is therefore very important to have a clear idea of what it means, for the chief turning points in the life history of all plants are connected with it, and the natural relationships of the different groups and their distribution according to those relationships depend largely upon a comparison of the reproductive processes in the various classes and orders. These studies are too intricate and technical to be even outlined here; suffice it to say that some of the gymnosperms — pines, yews, cycads, etc. — show striking similarities in their reproductive processes to those of the higher pteridophytes, and through them a repetition of the most salient features of the alternation of generations in the highest seed plants has been traced. Briefly stated, we may say that the stamens of spermatophytes, and the pistils, or rather the carpels, which we saw to be transformed leaves, represent the sporophylls (Sec. 370) of the higher pteridophytes. The pollen sacs and ovules are sporangia, bearing microspores and megaspores (Sec. 370), represented respectively by the pollen grains in the anther and the embryo sac in the ovule. These go through a series of microscopic changes in the body of the ovule analogous to the production of the oöspore in the archegonia of ferns and liverworts, but the process is so obscure that to an ordinary observer the pollen grains and ovule appear to be the real gametes, and were supposed to be such, by the older botanists. The fertilized germ cell in the embryo sac (Sec. 327) corresponds to an oöspore, the endosperm found in all seeds (previous to its absorption by the cotyledons) is a rudimentary gametophyte, and the embryo in the matured seed, the undeveloped sporophyte, destined, after germina-

tion and further growth, to produce a new generation of microspores; *i.e.* pollen grains, and megaspores (embryo sac), and so on, through the cycle.

376. Relative Importance of Gametophyte and Sporophyte.

— It is important to notice that the progressive diminution of the gametophyte in comparison with the sporophyte which we saw taking place in proceeding from the bryophytes to pteridophytes, reaches its climax in the spermatophytes, where it is reduced to such insignificance that it is only by certain analogies of structure and function that it can be recognized at all. It remains permanently inclosed within the walls of the ovary and is absorbed by the sporophyte during germination, or even earlier in those seeds classed as ex-albuminous. The sporophyte, on the other hand, represents the fully organized plant, and attains among dicotyledons the highest development of vegetable structure.

THE ALGÆ

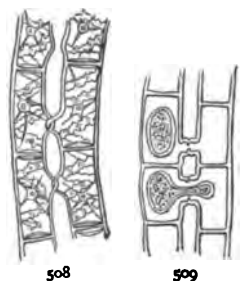
MATERIAL. — Collect in a bottle some of the green scum found in stagnant pools, ditches, and sluggish streams everywhere, and variously known as frog spit, pond scum, brook silk, etc. In cities and other places where specimens are not easily procured, it can be cultivated in a simple aquarium made of a wide-mouthed glass jar with a few pebbles and sticks at the bottom.

377. Variety of Forms. — This group embraces plants of the greatest diversity of form and structure, from the minute volvox and desmids that hover near the uncertain boundaries dividing the vegetable from the animal world, to the giant kelps of the southern ocean, which sometimes attain a length of from six hundred to one thousand feet. The fresh-water algæ are all very small, and those of them that are visible to the naked eye belong mostly to the filamentous group, so called from their slender threadlike thalli, that look like bits of fine green floss floating about in the water.

378. Examination of a Specimen. — Place a drop or two of fresh pond scum on a piece of glass and examine with

a lens. Of what does it appear to consist? Are the filaments all alike, or are they of different lengths and thickness? Soak a number of them in alcohol for half an hour and examine again; where has the green matter gone? Do these algæ contain chlorophyll? (Sec. 25).

379. Spirogyra. — The filamentous algæ are very numerous, and your drop of pond scum will probably contain several kinds. At least one of these, it



508, 509. — *Spirogyra* (magnified): 508, two filaments beginning to conjugate; 509, formation of spores.

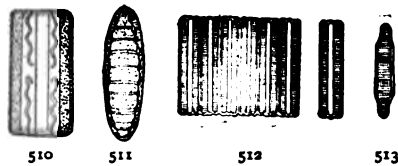
is likely, will be a *Spirogyra*, as this is one of the commonest and most widely distributed of them all. This genus takes its name from the spiral bands in which the chlorophyll is usually disposed (Fig. 508) within the cells. These bands are single in some species, in others they combine and intercross in various ways, forming most beautiful patterns when viewed under the microscope. Each filament is seen, when sufficiently

magnified, to consist of a number of more or less cylindrical cells joined together in a vertical row, and thus forming the simple threadlike thallus that characterizes this class of algæ. Physiologically, each cell is an independent individual, and often exists as such.

380. Vegetative Multiplication. — Some of the algæ, so far as our present knowledge goes, have only the one form of reproduction known as vegetative multiplication, or fission (splitting). A cell divides itself in two, each half grows into a distinct cell, which again divides, forming new cells, and so on, till millions of individuals may result from a single mother cell in a few days, or in some cases, in a few hours. This method of reproduction takes place in some form or other in almost all plants, the propagation by buds, tubers, rootstocks, runners, etc., among spermatophytes being nothing but a mode of vegetative multiplication.

381. Conjugation. — Another method of reproduction is by the formation of spores. In spirogyra and many other algæ the spores are formed by the method known as *conjugation*, that is, joining together. The cells of two adjacent filaments send out lateral protuberances toward each other (Fig. 509), and when the ends of these protuberances meet, the protoplasm in each contracts, the contents of one pass over into the other, the two coalesce and form a new cell but little, if any, larger than the original conjugating bodies. This cell germinates under favorable conditions and produces a new individual.

382. Diatoms and Desmids. — These two groups are alike in their microscopic size, in their simple structure, and in the interest that attaches to them on account of their enormous numbers and their great beauty and variety of form, but otherwise they are not nearly related orders. The diatoms are so different from all other vegetable structures that they are placed by some botanists in a class to themselves; others group them among the algæ. They consist of simple cells inclosed in a very hard mineral covering

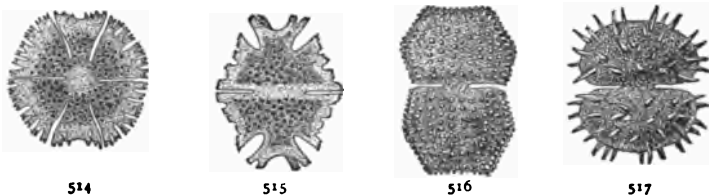


510-513. — Diatoms (highly magnified):
510, 511, *Grammatophora serpentina*; 512,
513, *Fragilaria virescens*.

formed of two valves, one of which fits over the other like the lid of a pasteboard box. They are of a brown color and of almost every conceivable shape (Figs. 510-513). Not less than ten thousand species have been described, and immense deposits of rock in various parts of the world are formed by the flinty coverings of millions of these microscopic creatures that once floated in the seas of past geologic ages.

The desmids were for a long time classed with animals, but have now been handed over definitively to the botanist. They are of a bright green color, and are further distinguished from the diatoms by their perfect bilateral sym-

metry; that is, both sides of a cell are just alike. They are found only in fresh water; diatoms inhabit either salt water or fresh.



514-517.—Desmids (highly magnified): 514, *Microsterias papillifera*; 515, *Microsterias morsa*; 516, *Cosmarium polygonum*; 517, *Xanthidium aculeatum*.

383. Place in Nature.—Algæ exist in vast multitudes both as to the number of species and of individuals. They all contain chlorophyll, but in a few fresh-water forms and in most seaweeds it is obscured by pigments of brown or red to which the brilliant coloration of these plants is due. The presence of these pigments probably has some relation to their peculiar environment, especially in the case of those growing in deep water, where the action of light upon the chlorophyll is greatly diminished and altered by refraction. Their variations in color form a convenient basis of classification, and botanists divide algæ into six great orders, according to their color. The spirogyra and most fresh-water species belong to the order of *Chlorophyceæ*, or Green Algæ. This class is of special interest because from it all the higher forms of vegetable life are believed to have been derived.

PRACTICAL QUESTIONS

1. Are any of the green algæ parasitic? How do you know? (25.)
2. What is their effect upon the atmosphere; that is, do they tend to purify it by giving off oxygen, or the reverse? (24, 25.)
3. Why is their presence in water regarded as denoting unhygienic conditions?
4. Refer to the experiment in Section 22, and account for the bubbles and froth that usually accompany these plants in the water.
5. Can you suggest any other causes than the elimination of oxygen that might produce the same effect?
6. Is the presence of these gas bubbles of any use to the plants?
7. Should you expect to find parasites among the green algæ? Why?

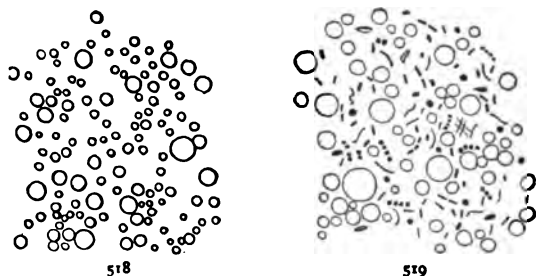
XI. FUNGI

THEIR CLASSIFICATION

384. What is a Fungus? — The fungi are all (with a few doubtful exceptions) parasites or saprophytes which have lost their chlorophyll and become incapable of supporting an independent existence. Biologists are divided as to their position in the genealogical tree of life. The weight of authority at present seems to incline to the view that they are degenerate forms derived from the algæ, while others regard them not as degraded descendants of higher forms, but as representatives of the lowest primordial types from which higher organizations have arisen. If they represent a degraded and degenerate type, they have been so modified by their parasitic habits as greatly to obscure their relationship and render their position in the general scheme of life a very doubtful one. They represent an offshoot, or side branch as it were, of the great evolutionary line, and so will be considered in a chapter by themselves.

385. Economic Importance. — On account of their immense numbers, reaching at present the enormous total of forty-five thousand known species, and of the parasitic habit, which causes them to enter the bodies of other plants and of animals, fungi are of great economic importance, especially the various microscopic forms grouped under the head of Bacteria. These, by their rapid multiplication within the blood and the tissues of their victims, produce the most fatal and destructive diseases. They are the smallest living organisms, and are always floating in the atmosphere, so that with every breath we draw, large numbers

of them are inhaled. Fortunately, however, most of them are harmless, unless inhaled in very great numbers or



518, 519. — Milk (highly magnified): 518, pure, fresh milk; 519, milk that has stood for hours in a warm room in a dirty dish, showing fat globules and many forms of bacteria.

under certain unhealthful conditions, while a few, such as the yeast fungus and the bacteria concerned in the processes of decomposition, are very useful. The presence of



520-523. — Forms of bacteria: 520, bacteria of consumption (*Bacillus tuberculosis*); 521, cholera bacillus; 522, bacilli of anthrax, showing spores; 523, typhoid bacillus.

bacteria in the soil is also of importance sometimes, since through their agency the nitrogen compounds are rendered soluble by the roots of plants (Sec. 198).

386. Difficulty of Classification. — The life history of fungi in general is very obscure and difficult to trace, both on account of the microscopic size of the great majority of them, and of the curious habit of polymorphism exhibited by many species; that is, the same individual appears under entirely different forms at different stages of its ex-

istence, like an insect undergoing metamorphosis, so that it is often impossible to tell whether a given specimen belongs to a distinct group or is merely a form of the same species at a different stage of its existence.

Our knowledge of them being so imperfect, their classification is in great confusion, and any grouping of them must be considered as in a great measure provisional only.

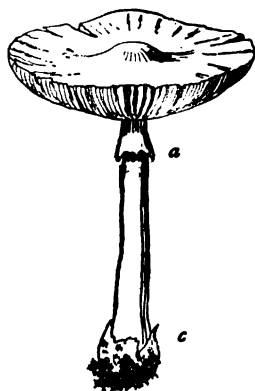
PRACTICAL QUESTIONS

1. Why ought preserved fruits and vegetables to be scalding hot when put into the can? (385.)
2. Why is it necessary to exclude the air from them? (385.)
3. Why does using boiled water for drinking render a person less liable to disease? (142, 385.)

MUSHROOMS

MATERIAL.—Any kind of gilled mushroom in different stages of development, with a portion of the substratum on which it grows, containing some of the so-called spawn. In city schools the common mushroom sold in the markets (*Agaricus campestris*) can usually be obtained without difficulty. It would be advisable to buy some of the spawn and raise a crop in the schoolroom, as then all parts of the plant would be on hand for examination. Full directions for cultivating this fungus are given in Bulletin 53 of the U.S. Department of Agriculture. From six to twelve hours before the lesson is to begin, cut the stem from the cap of a mature specimen close up to the gills, lay the gills downward on a piece of clean paper, cover them with a bowl or pan to keep the spores from being blown about by the wind and leave them until a print (Fig. 532) has been formed.

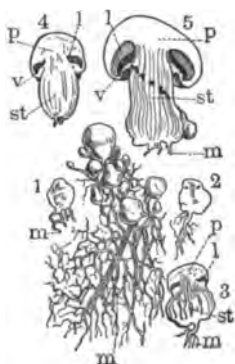
387. Examination of a Typical Specimen.—The most highly specialized of the fungi, and the easiest to observe on account of their size and abundance, are the mushrooms that are such familiar objects after every summer shower. The gilled kind—those with the rayed laminæ



524.—Deadly agaric (*Amanita phalloides*), showing the broad pendent annulus, *a*, formed by the ruptured veil, the cup at the base, *c*, and floccose patches on the pileus, left by the breaking up of the volva.

under the cap—are usually the most easily obtained. Gather a specimen of some of these according to the directions given above, and examine them as soon as possible, since they decay very quickly.

388. The Mycelium.—Examine some of the white fibrous substance usually called spawn, through a lens.



525.—Mycelium of a mushroom (*Agaricus campestris*) with young buttons (fruiting organs) in different stages: 1, 2, 3, 4, 5, sections of fructification at successive periods of development, m, mycelium; st, stipe; p, pileus; l, gill, or lamina; v, veil.

Notice that it is made up of fine white threads interlacing with each other, and often forming webby mats that ramify to a considerable distance through the substratum of rotten wood or other material upon which the fungus grows. These threads are called *hyphae*, and are apt to be mistaken for roots, but they are really the thallus or true vegetative body of the plant, the part rising above ground and usually regarded as the mushroom, being only the fruit, or reproductive organ. The thallus of all fungi is called a *mycelium* from *mycetes*, a Greek word meaning fungi.

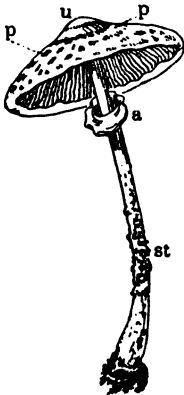
389. The Button.—Look on the mycelium for one of the small round bodies called buttons (Fig. 525). These are the beginning of the fruiting body, popularly known as the mushroom, and are of various sizes, some of the youngest being barely visible to the naked eye. After a time they begin to elongate and make their way out of the substratum.

390. The Veil and Volva.—Make a vertical section through the center of one of the larger buttons after it is well above ground, and sketch. Notice whether it is entirely enveloped from root to cap in a covering membrane—the *volva* (Fig. 526, a)—or whether the enveloping membrane extends only from the upper part of the stem to the margin of the cap—the *veil* (Fig. 526, d'); whether it has

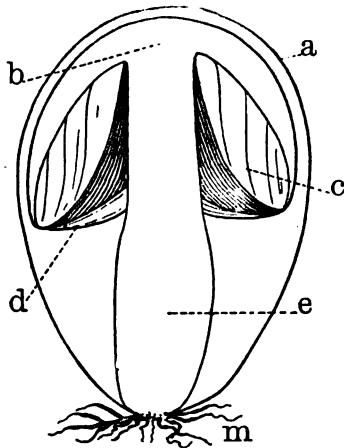
both veil and volva, or finally whether it is naked, that is, devoid of both.

Next take a fully expanded specimen and observe

391. The Stipe, or stalk. Notice as to length, thickness, color, and position, that is, whether it is inserted in the center of the cap or to one side (excentric), or on one edge (lateral). Observe the base, whether bulbous, tapering, or straight, and whether surrounded by a cup, or merely by concentric rings or ragged bits of membrane (the remains of the volva). Look for the annulus or ring (remains of the veil) near the insertion of the stipe into the cap, and if there is one, notice whether it adheres to the stipe, or moves freely up and down as in Figure 527, *a*;



527.—Parasol mushroom (*Lepiota procera*), showing movable annulus: *st*, stipe; *a*, annulus, or ring; *u*, umbo; *p, p*, floccose patches left by volva.



526.—Diagram of unexpanded *Amanita*, showing parts: *a*, volva; *b*, pileus; *c*, gills; *d*, veil; *e*, stipe; *m*, mycelium.

whether it is thick and firm, or broad and membranous so that it hangs like a sort of curtain round the upper part of the stipe (Fig. 524, *a*). Break the stem and notice whether it is hollow or solid, observe also the texture, whether brittle, cartilaginous, fibrous, fleshy, etc. Next observe the

392. Pileus, or cap, as to color and surface, whether dry, or moist and sticky; smooth, or covered with scurf or scales left by the remains of the volva, as it was stretched and broken up by the expanding cap (Fig. 527, *p, p*). Note also the size and shape, whether conical, expanded, funnel shaped

(infundibuliform, Fig. 528); umbonate, having a protuberance at the apex (Fig. 527), etc; whether the margin is turned up at the edge (revolute, Fig. 524), or under (involute, Fig. 527). Look at the under surface and examine

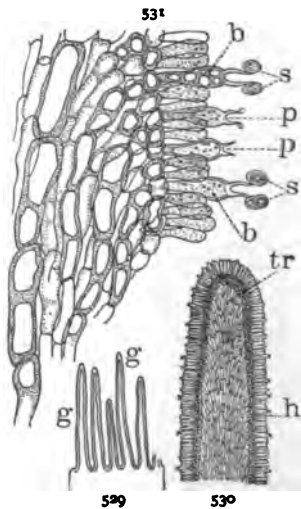


528. — Chanterelle (*Cantharellus cibarius*), with infundibuliform pileus and decurrent gills.

393. **The Gills, or laminae.** — Notice whether they are broad or narrow, whether they extend straight from stem to margin or are rounded at the ends, or are curved, toothed, or lobed in any way. Notice their attachment to the stipe, whether free, not touching it at all; adnate, attached squarely to the stem at their anterior ends; or decurrent, running down upon the stem for a greater or less distance (Fig. 528).

394. **The Hymenium.** — Cut a tangential section through one side of the pileus and sketch as it appears under the lens. If a very thin cross section of one of the gills is made and placed under the microscope it will appear as in Figure 529. More highly magnified sections are shown in Figures 530, 531. The blade of the gill, called the *trama*, is covered on both sides by a membranous layer bearing elongated club-shaped cells set

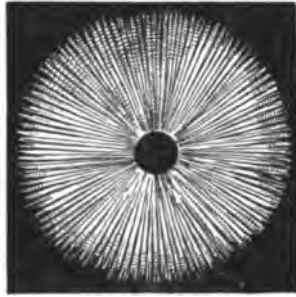
531. **The Gills, or laminae.** — Notice whether they are broad or narrow, whether they extend straight from stem to margin or are rounded at the ends, or are curved, toothed, or lobed in any



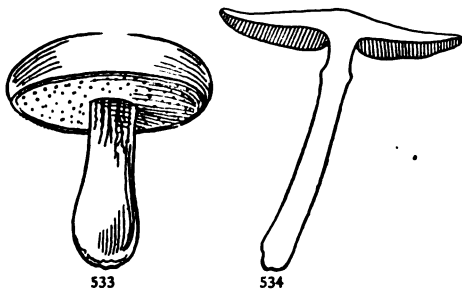
529-531. — Sections of a gilled mushroom: 529, through one side, showing sections of the pendent gills, *g*, *g*, (slightly magnified); 530, one of the gills more enlarged, showing the central tissue of the trama, *tr*, and the broad border formed by the hymenium, *h*; 531, a small section of one side of a gill very much enlarged, showing the club-shaped basidia, *b*, *b*, standing at right angles to the surface, bearing each two small branches with a spore, *s*, *s*, at the end. The sterile paraphyses, *p*, are seen mixed with the basidia.

upon it at right angles to the surface (Fig. 530). Some of these put out from two to four, or in some species as many as eight little prongs, each bearing a spore (Fig. 531, s, s), while others remain sterile. The spore-bearing cells are called *basidia*, the sterile ones, *paraphyses*, and the whole spore-bearing surface together, the *hymenium*, from a Greek word meaning a membrane. It is from the presence of this expanded fruiting membrane that the class of mushrooms we are considering gets its botanical name, *Hymenomycetes*, membrane fungi.

395. Spore Prints. — When the gills are ripe they shed their spores in great abundance. Take up the pileus that was laid on paper as directed under *Material*, on page 273, and examine the print made by the discharged spores; it will be found to give an exact representation of the under side of the pileus.



532.—Spore print of a gilled mushroom.

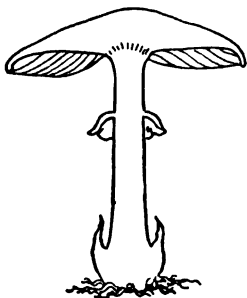


533, 534.—A tube fungus (*Boletus edulis*): 533, entire; 534, section, showing position of the tubes.

to which the edible boletus belongs (Figs. 533, 534), the basidia are placed along the inside of little tubes that line the under side of the pileus, giving it the appearance of a honeycomb.

In another order, the porcupine fungi, they are arranged on the outside of projecting spines or teeth, while in the morels they are held in little cups or basins.

396. The Spores. — Notice the color of the spores as shown in the spore print. This is a matter of importance in distinguishing gill-bearing fungi, which are divided into five sections according to the color of the spores. One source of danger, at least, to mushroom eaters would be avoided if this difference was always attended to, for the deadly amanita (*A. phalloides*), and the almost equally



535.—Diagram of a gilled mushroom.

dangerous fly mushroom (*A. muscaria*), both have white spores, while the favorite edible kind (*Agaricus campestris*), though white gilled when young, produces dark, purple-brown spores that can not fail to distinguish it clearly for any one who will take the trouble to make a print.

Sketch a longitudinal section through the center of a well-developed mushroom, as shown in Figure 535, labeling the different parts that you can distinguish, and bringing out as well as you can the points observed in your examination of the living specimen.

397. Mushrooms and Toadstools. — The popular distinction which limits the term "mushroom" to a single species, the *Agaricus campestris*, and classes all others as toadstools, has no sanction in botany. All mushrooms are toadstools and all toadstools are mushrooms, whether poisonous or edible. The real distinction is between mushrooms and puff balls, the former term being more properly applied only to that class of fungi which have the hymenium or spore-bearing surface exposed.

398. Food Value. — The food value of mushrooms has been greatly exaggerated. They contain a large proportion of water, often over ninety per cent, and the most valued of them, the *Agaricus campestris*, bears a very close resemblance to cabbage in its nutrient properties. They are pleasant relishes, however, and as agreeable articles of diet, are not to be despised.

PRACTICAL QUESTIONS

1. Why are mushrooms generally grown in cellars? (25, 384)
2. Name any fungi you know of that are good for food or medicine or any other purpose.
3. Name the most dangerous ones you know of.
4. Do you find fungi most abundant on young and healthy trees, or on old, decrepit ones? Account for the difference. (384.)
5. Do you ever find them growing upon perfectly sound wood anywhere?
6. Is it wise to leave old, unhealthy trees and decaying trunks in a timber lot?

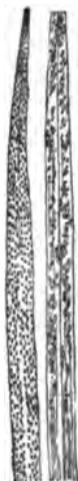
RUSTS

MATERIAL.—A leaf of wheat affected with red rust. A leaf or a stalk with black rust. Some barberry leaves with yellowish pustules on the under side that look under the lens like clusters of minute white corollas (see Fig. 542). As the spots on barberry occur in spring, the red rust in summer, and the black rust in autumn, the specimens will have to be gathered as they can be found, and preserved for use.

In the southern States barberry occurs but rarely or not at all, and a different species of rust, the orange leaf (*Puccinia rubigo-vera*), is more common than the ordinary wheat rust (*Puccinia graminis*), but the two are so much alike that the directions given will do for either. If the orange leaf rust is used, the cups and pustules should be looked for on plants of the borragae family—comfrey, hound's-tongue, etc. Leaves of oats or other infected grasses may be used, but wheat is to be preferred, as the life history of the common wheat rust (*P. Graminis*) has been more clearly traced than that of any other variety. The apple scab fungus may be used instead of wheat if more convenient. In this case, provide apple or haw leaves affected with scab, and some of the common excrescences known as cedar apples.

399. Red Rust.—Uredo Stage. Examine a leaf of "red rusted" wheat under the lens, and notice the little oblong brown dots that cover it. These are the sori, or clusters of sporangia that have formed upon the surface. Viewed under the microscope the red rust is seen to consist of a mycelium that ramifies through the tissues of the leaf and bears clusters of single-celled reddish spores that break through the epidermis and form the reddish brown spots and streaks from which the disease takes its name. These spores, falling upon other leaves, germinate in a few

hours and form new mycelia, from which, in six to ten days, fresh spores arise. Formerly this was thought to complete the life history of the fungus, to which the name of *Uredo* was given. It is now known, however, that the red rust is merely a stage in the life cycle of the plant, and to this stage the old name *uredo* is applied, and the spores are called uredospores.



536 537

536, 537. — Leaf of wheat affected with orange leaf rust, *Puccinia rubigo-vera*, uredo stage: 536, upper side of leaf; 537, under side.

400. Black Rust. — Next examine with your lens a part of the plant attacked by black rust. Do you observe any difference except in the color? Do the two kinds of rust attack all parts of the plant equally? If not, what part does each seem to affect more particularly? At what season does the black rust appear most abundantly?

It was formerly supposed that black rust was caused by a different fungus from that producing red rust, and to it the name *Puccinia* was given, but it is now known to be only another phase of the same parasite that produces the red rust. The name "*Puccinia*" is retained as a general designation for all fungi undergoing these two phases, and the particular form of fungus that we are now considering is known in all its stages as *Puccinia graminis*.



538. — Stalk with *Puccinia graminis*, teleuto stage.

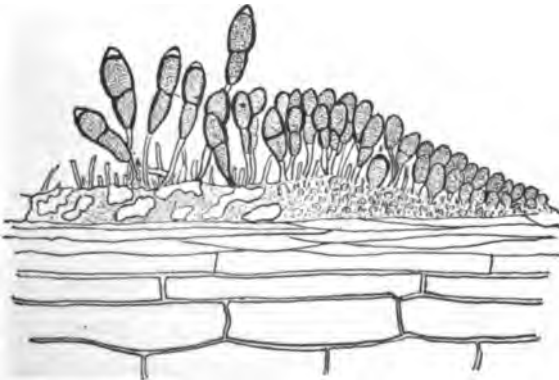
401. Teleutospores. — Toward the end of summer the same mycelium that bore the uredospores begins to develop the dark spore clusters that give to black rust its characteristic color and its name. After this the uredospores soon cease to be developed at all, and only the dark ones called teleutospores are produced. These remain on the culms in the stubble fields over winter, ready to begin

the work of reproduction in spring, whence they are called "winter spores," in contradistinction to the uredos or "summer spores," whose activity seems to be confined to the warm months.



539.—Uredospores of wheat rust, *Puccinia graminis*, magnified (from COULTER'S "Plant Structures").

Under the microscope the teleutospores appear as long, two-celled bodies with very thick black walls (Fig. 540). Since they are developed from the same mycelium with the



540.—Teleutospores of wheat rust, magnified (from COULTER'S "Plant Structures").

uredospores, and are not a product of the latter, but collateral with them, the two constitute a single generation, and belong to one and the same stage in the life history of the plant.

402. Sporidia.—In spring the teleutospores begin to germinate, each cell producing a small filament, from which arise in turn several small branches. Upon the tip

of each of these branches is developed a tiny sporelike body called a *sporidium* (Fig. 541), which continues the generation of the rust fungus through the next stage of its existence. The filament which bears these sporidia is not parasitic, but when the sporidia ripen and the spores contained in them are scattered by the wind, there begins a second parasitic phase, which forms the most curious part of this strange life history.



541. — Teleutospore germinating and forming sporidia, s, s, (from COULTER'S "Plant Structures").

More highly magnified, this yellow substance is seen to be composed of regular layers of colored spores. The corolla-like receptacles containing them, popularly known as "cluster cups," are borne on a mycelium produced from the spores described in the last paragraph. This mycelium is parasitic on barberry or other leaves, according to the kind of fungus, and was long believed to be a distinct plant, to which the name *Æcidium* was given. This term (pl. *Æcidia*) is now applied to the cluster cups, and those fungi which at any period of their life history produce them are called *Æcidium* fungi.

403. The *Æcidium*. — Examine now the under side of your barberry leaves (or comfrey, etc., if red rust is used), for clusters of small whitish bodies that appear under the lens like little white corollas with yellow anthers in the center.



542. — Cluster cups of apple rust (*Rostelia*), the *æcidium* stage of the "cedar apple" fungus.

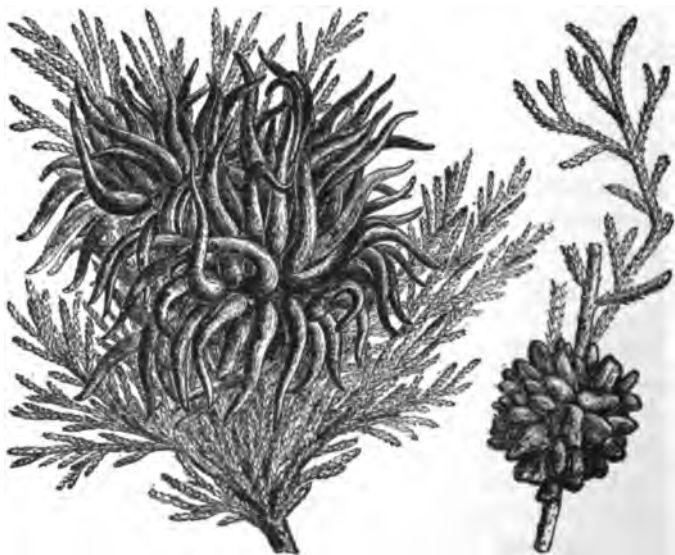
404. Connection between Barberry and Wheat Rust. — There had long existed a popular belief, both in this country and in England, that the presence of barberry bushes near grain fields produced rust, or mildew, as it is called in Eng-

land. There is a village in Norfolk that long went by the name of "Mildew Rollesby," on account of the mildewed grain caused, it was believed, by the abundance of barberry bushes in the neighborhood. These were cut down and mildew at once disappeared. Repeated instances of the kind led a few men of science to suspect that the popular belief might be something more than a mere superstition, after all. Experiments were made which showed that grain planted in the vicinity of a barberry bush infected with *æcidia* developed rust immediately after the *æcidia* spores matured, and that rust was most abundant in the direction in which the wind carried the spores. Further experiment showed that *æcidia* spores would not germinate directly on barberry; in other words, *æcidia* would not reproduce *æcidia* directly, but only after passing through one or more intermediate stages, and thus it was proved beyond a doubt that these fungi are not independent plants, but merely a phase in the life history of the Puccinia.

405. The Life Cycle.—Taking the first phase of the season as our starting point, the life cycle of the wheat rust consists of three stages carried on by four different kinds of spores: (1) The non-parasitic stage, which originates from teleutospores, and produces sporidia; (2) The *æcidium* phase, which arises from the sporidia, is parasitic on barberry, and produces spores that germinate on grain; (3) The *uredo*-teleuto phase, parasitic on grain. The first, or sporidia stage, which is too small to be discoverable except by the microscope, escapes the notice of the ordinary observer, and the third, producing two kinds of spores, *uredo* and teleuto, has the appearance of being two separate stages, so that to one unacquainted with the facts, the life cycle would seem to consist of a red rust or *uredo* stage, a black rust, or teleuto stage, and an *æcidium* stage. The last is often omitted. In many cases, as in our own southern States, where there are no barberries to act as hosts, the sporidia germinate directly upon young wheat, without passing through the cluster cup stage, and the orange leaf

rust is known to be capable of propagating year after year in the uredo stage alone,¹ the spores surviving through the winter on volunteer grains and other grasses.

406. Cedar Apples. — An excellent subject for study is the common fungus (*Gymnosporangium*) that produces upon red cedar twigs the large excrescences familiarly known as "cedar apples." It is related to the wheat rusts, but has only two phases, its spores germinating and pro-



543. — Two species of "cedar apple" (*Gymnosporangium*), showing stage of the apple rust fungus corresponding to the uredo-teleuto stages of wheat rust (from COULTER'S "Plant Structures").

ducing æcidia upon the leaves of apple, hawthorn, and other kindred plants. In this stage it is known as *Rostelia*, and is the cause of apple rust and other similar orchard diseases. Specimens are generally easy to obtain and can be studied by the same methods outlined in the foregoing paragraphs.

407. Polymorphism. — Plants that pass through different stages in their life history are said to be *polymorphic*, that

¹ Bulletin 16, United States Department of Agriculture.

is, of many forms. The habit is very common among the lower forms of vegetation. The fact that one or more of the phases are sometimes omitted, as the *æcidium* phase of wheat rust in warm climates, suggests the idea that it may be of use in helping the plant to tide over difficult conditions. Blackberry, anemone, groundsel, buckthorn, and many other common plants are known to harbor *æcidia*, but what particular species of *uredo* and *puccinia* and *æcidium* belong together in any one case, it is impossible to determine without continued observation and experiment.

408. Difference between Polymorphism and Alternation of Generations.—These two processes must not be confounded. A polymorphic plant, so far as we know, may reproduce itself indefinitely by means of simple spores without the intervention of gametes and oöspores, but to constitute an alternation of generations there must intervene somewhere in the life history the union of two unlike spores (gametes) to form an oöspore, with the alternate appearance of sporophyte and gametophyte.

PRACTICAL QUESTIONS

1. Is a farmer wise to leave scabby and mildewed weeds and bushes in the neighborhood of his grain fields? (407.)
2. Are there any objections to the presence of volunteer grain stalks along roadsides and in fence corners during winter? (405.)
3. Should cedar trees be allowed to grow near an apple orchard? Give a reason for your answer. (406.)
4. Should diseased plants be plowed under? (402.)
5. What disposition should be made of them?
6. Ought diseased fruits be left hanging on the tree?
7. Why is it necessary to pick over and discard from a crate or bin all decaying fruits and vegetables?

FIELD WORK

The study of fungi can be carried on only to a very limited extent without the use of a compound microscope, and all serious work of the kind must be conducted in the laboratory. The general observer, however, may do some practical work by learning to recognize the various

blights, rusts, mildews, etc., by their effects upon the vegetation of his neighborhood. Learn to know at a glance whether a given field or orchard is suffering from leaf curl, scab, the yellows, bunt, smut, mildew, etc.

A systematic study of mushrooms will be found very interesting from both a scientific and a dietetic point of view for those who have leisure to undertake it and means to expend on the rather costly literature that deals with the subject.

SYSTEMATIC BOTANY

409. Now that some knowledge has been obtained of the structure of plants, their analysis and classification can be taken up with both profit and pleasure. To know the place of a species in the great scheme of life, and understand what is to be expected of it in its normal family relations is necessary before we can appreciate justly its adaptations to the surrounding conditions in its struggle for existence. It is not advisable to spend too much time in the mere identification of species, but enough should be examined and described to familiarize the student with the distinctive characteristics of the principal botanical groups.

410. Botanical Terminology is in a very unsettled state at present, owing to disagreements among botanists as to the use of certain terms, but this does not affect the general principles of classification and nomenclature. All the known plants in the world, varied and multitudinous as they are, numbering not less than one hundred and twenty thousand species of the seed-bearing kind alone, are ranged according to certain resemblances of structure, into a number of great groups known as families or orders. The names of these families are distinguished by the ending *aceæ*; the rose family, for instance, are the *Rosaceæ*; the pink family, *Caryophyllaceæ*; the walnut family, *Juglandaceæ*, etc.

411. Genera and Species. — Each of these families is divided into lesser groups called *genera* (singular, *genus*), characterized by similarities showing a still greater degree of affinity than that which marks the larger groups or orders; and finally, when the differences between the individual plants of a kind are so small as to be disre-

garded, they are considered to form one species, just as all the common morning-glories, of whatever shade or color, belong to the species *Ipomea purpurea*. The small differences that arise within a species as to the color and size of flowers, and other minor points, constitute mere varieties and have no special names applied to them. The line between varieties and species is not clearly defined, and in the nature of things can never be, since progressive development, through slow but unceasing change, is the law of all life.

In botanical descriptions the name both of the species and of the genus is given, just as in designating a person, like Mary Jones or John Robinson, we give both the surname and the Christian name. The genus, or generic name, answers to the surname, and that of the species to the Christian name — except that in botanical nomenclature the order is reversed, the generic, or surname coming first, and the specific or individual name last; for example, *Ipomea* is the generic, or surname, of the morning-glories, and *purpurea* the specific one.

412. How to use the Key. — Any good manual will do; Gray's "School and Field Book" is perhaps the best available at present for the States east of the Mississippi. A little reference to what has already been said on the subject of classification in Sections 126-129, will make its use clear. Suppose we want to find out to what botanical species the morning-glory, or the sweet potato, for instance, belongs. Turning to the key we find the sub-kingdom of Phænerogams — flowering, or seed-bearing plants — divided into two great classes, Angiosperms and Gymnosperms, as already explained in the Sections referred to. A glance will show that our specimen belongs to the former class. Angiosperms, again, are divided into the two subclasses of Dicotyledons and Monocotyledons (Sec. 129). We at once recognize our plant, by its net-veined leaves and pentamerous flowers as a dicotyledon (Secs. 37, 302), and turning again to the key, we find this

subclass divided into three great groups: Sympetalous (called also Monopetalous and Gamopetalous); Apopetalous (or Polypetalous); and Apetalous. A glance will refer our blossom to the sympetalous or monopetalous group, which we find divided into two sections, characterized by the superior or inferior ovary (Secs. 289, 294). A little examination will show that the morning-glory belongs to the former class, which is in turn divided into two sections, according as the corolla is *regular*, or *more or less irregular*. We see at once that we must look for our specimen in the former class. This we find again subdivided into four sections according to the number and position of the stamens, and we find that the morning-glory falls under the last of these; "Stamens as many as the lobes or parts of the corolla and alternate with them." A very little further search brings us to the family *Convolvulaceæ*, and turning to that title in the descriptive analysis, page 306, we find under the genus, *Ipomea*, a full description of the common morning-glory, in the species *Ipomea purpurea*, and of the sweet potato in the species *Ipomea batatas*.

APPENDIX

BOOKS FOR READING AND REFERENCE

An excellent bibliography, accompanied by short explanatory notices of the works most useful to teachers of botany, will be found in the seventh chapter of Ganong's *Teaching Botanist*, which the reader is advised to consult. Some of the books mentioned there, however, are too technical to fall within the scope of this work, and others of value have appeared since the list was compiled. The references in the following pages have been arranged, as far as possible, with regard to the subjects treated in the different chapters of the present work; but the order of treatment by different authors varies so, that it has been impossible to specialize closely. Some of the references given under one head will be found to contain matter equally applicable to other subjects, and what is suitable for one section of a chapter will perhaps have no connection with the other parts of the same chapter. The most that can be done is to furnish a list for general guidance, as an aid to those teachers who have not access to well-stocked libraries.

The price of all the works named has been given wherever it could be ascertained, and also the address of the publishers and date of publication. Where more than one reference is made to the same work, these data are omitted after the first. With one or two exceptions, no foreign publications, unless reprinted in this country, are included in the list. Nearly all the articles quoted from the *Year Books of the Department of Agriculture*, and other government publications, have been reprinted in pamphlet form, and can be obtained free by addressing the Bureau of Publication, United States Department of Agriculture, Washington, D.C. A circular containing a list of all the publications of the department will be sent free on application.

CHAPTER II

- Allen: *Story of the Plants*. Chaps. IV and V. D. Appleton & Company, N.Y. 35 cents.
Darwin: *Insectivorous Plants*. D. Appleton & Company. 1886. \$2.00.
Gray: *Structural Botany*, pp. 85-131. American Book Company, N.Y. 1880. \$2.00.

- Goodale: *Physiological Botany*, pp. 337-353 and 409-424. American Book Company. 1885. \$2.00.
- Leavitt: *Outlines of Botany*, pp. 66-98. American Book Company. 1901. \$1.00.
- Lubbock: *Flowers, Fruits, and Leaves*; Last Part. Macmillan Company, N.Y. 1884. \$1.25.
- Ruskin: *Modern Painters*. Vol. V, Chaps. I, II, IV, V, IX, X. John Wiley & Sons, N.Y.
- Dana: *Plants and Their Children*, pp. 135-185. American Book Company. 1896. 65 cents. (An elementary work, but full of excellent suggestions and examples.)
- Thoreau: *Autumn Tints*, from "Excursions in Field and Forest." Houghton, Mifflin & Company, Boston. 1891. \$2.00.
- Treat: *Home Studies in Nature*. Part III. American Book Company. 90 cents.
- Ward: *Disease in Plants*. Chaps. III and IV. Macmillan Company. 1901. \$1.60.
- Report of the Division of Forestry: United States Department of Agriculture. 1899.

CHAPTER III

- Bailey: *The Evolution of Our Native Fruits*. Macmillan Company. 1898. \$2.00.
- Gray: *Structural Botany*. Chap. VII.
- Leavitt: *Outlines of Botany*, pp. 147-156.
- Lubbock: *Flowers, Fruits, and Leaves*. Part II.
- Thoreau: "The Succession of Forest Trees" and "Wild Apples," from "Excursions in Field and Forest."
- Dana: *Plants and Their Children*, pp. 27-49.

CHAPTER IV

- Dana: *Plants and Their Children*, pp. 50-98.
- Goodale: *Physiological Botany*, pp. 205 and 384-396.
- Leavitt: *Outlines of Botany*, pp. 7-23.
- Lubbock: *Seeds and Seedlings*. D. Appleton & Company. 1892. 4 vols. \$10.00.
- Year Book of the United States Department of Agriculture. 1894. Pure Seed Investigation, pp. 389-408; Water as a Factor in the Growth of Plants, pp. 165-176.
- Year Book. 1895. Oil-producing Seeds, pp. 185-204; Testing Seeds at Home, pp. 175-184.
- Year Book. 1896. Migration of Weeds, pp. 263-286; Superior Value of Large, Heavy Seed, pp. 305-322.

- Year Book. 1897. Additional Notes on Seed Testing, pp. 441-452.
Year Book. 1898. Improvement of Plants by Selection, pp. 355-376.
Grass Seed and its Impurities, pp. 473-494.

CHAPTER V

- Gray: Structural Botany, pp. 27-39 and 56-64.
Leavitt: Outlines of Botany, pp. 34-45; 58-60.
Ward: Disease in Plants. Chaps. V, VI, and VII.
Year Book of the United States Department of Agriculture. 1894
Grasses as Sand and Soil Binders, pp. 421-436.

CHAPTER VI

- Apgar: Trees of the Northern United States. Chaps. II, V, and VI.
American Book Company. 1892. 55 cents.
Leavitt: Outlines of Botany, pp. 45-56; 212-226; 229-240.
Pinchot: A Primer of Forestry. Bulletin No. 24. Division of Forestry: United States Department of Agriculture. 1899.
Popular Science Monthly, September, 1901. Plants as Water Carriers.
Popular Science Monthly, March, 1902. The Palm Trees of Brazil.
Ward: The Oak. D. Appleton & Company. 1892. \$1.00.
Ward: Disease in Plants. Chaps. XXI, XXII, XXVI, XXIX.
Ward: Timber and Some of its Diseases. The Macmillan Company. 1889. \$1.75.
Year Book. 1894. Forestry for Farmers, pp. 461-500. (Bulletin 67.)
Year Book. 1895. Principles of Pruning and Care of Wounds in Woody Plants, pp. 257-268.
Year Book. 1898. Pruning of Trees and Other Plants, pp. 151-166.

CHAPTER VII

- Gray: Structural Botany. Chap. V.
Huntington: Studies of Trees in Winter. Knight & Millet, Boston. 1900. \$2.25.
Leavitt: Outlines of Botany, pp. 23-33 and 138-143.
Lubbock: Buds and Stipules. D. Appleton & Company. \$1.25.
Ruskin: Modern Painters. Chaps. III, VI, and VII.

CHAPTER VIII

- Allen: Flowers and Their Pedigrees. D. Appleton & Company. \$1.50.
Dana: Plants and Their Children, pp. 187-255.
Darwin: Different Forms of Flowers of the same Species. D. Appleton & Company. \$1.50.

- Darwin: On the Fertilization of Orchids. \$1.75.
- Darwin: Cross- and Self-fertilization in the Vegetable Kingdom. Chaps. I and II. \$2.00. Both by D. Appleton & Company. 1886.
- Gray: Structural Botany, pp. 163-214; 215-242.
- Henslow: The Origin of Floral Structures through Insects and Other Agencies. D. Appleton & Company. 1895. \$1.75.
- Leavitt: Outlines of Botany, pp. 99-138.
- Lubbock: Flowers, Fruits, and Leaves; First Part.
- Lubbock: British Wild Flowers in Relation to Insects. Macmillan Company. 1893. \$1.25.
- Müeller: The Fertilization of Flowers. Macmillan Company. 1893. 21s. (about \$5.00).
- Trelease: The Yucca Moth and Yucca Pollination. (Report of the Missouri Botanical Garden.) 1892.
- Ward: Disease in Plants. Chap. VIII.
- Year Book. 1896. Seed Production and Seed Saving, pp. 207-216.
- Year Book. 1897. Hybrids and Their Utilization in Plant Breeding, pp. 383-420.
- Year Book. 1898. Pollination of Pomaceous Fruits, pp. 167-180.
- Year Book. 1899. Progress of Plant Breeding in the United States, pp. 465-490.
- Year Book. 1900. Smyrna Fig Culture in the United States, pp. 79-106.

CHAPTER IX

- Allen: Colin Clout's Calendar. Particularly Chaps. XXXVI-XXXVIII. Funk & Wagnalls Company, N.Y. 1883. Cloth, \$1.00; paper, 25 cents.
- Bailey: The Survival of the Unlike. Macmillan Company. 1897. \$2.00.
- Darwin: The Variation of Animals and Plants under Domestication. Chaps. IX-XII. D. Appleton & Company. 2 vols. \$5.00.
- Dawson: The Geological History of Plants. D. Appleton & Company. \$1.75.
- Ward: Disease in Plants. Chaps. VII, X, XI, XVII, and XIX.
- Contributions from the United States National Herbarium:—
- The Plant Covering of Ocracoke Island. Thomas Kearney. Vol. V, No. 5. 1900.
- Plant Life of Alabama. Chas. Mohr. Vol. VI. 1901.
- Year Book. 1894. The Geographic Distribution of Animals and Plants in North America, pp. 203-214.
- Year Book. 1895. The Grasses of Salt Marshes, pp. 325-332.
- Year Book. 1898. Weeds in Cities and Towns, pp. 193-200. Forage Plants on Alkali Soils, pp. 535-550.
- The Water Hyacinth in its Relation to Navigation in Florida. Bulletin 18. United States Department of Agriculture.

CHAPTER X

- Clute: *Our Ferns in Their Native Haunts*. Frederick A. Stokes & Company, N.Y. 1901. \$2.15.
- Huxley and Martin: "Algæ" and "A Study of *Pteris Aquilina*," from "A Course of Elementary Instruction in Practical Biology." Macmillan Company. 1886. \$2.60.
- Leavitt: *Outlines of Botany*, pp. 163-183, 198-212.
- Parsons (Mrs. Dana): *How to know the Ferns*. Charles Scribner's Sons, N.Y. 1899. \$1.50.
- Underwood: *Our Native Ferns and Their Allies*. 6th revised edition. Henry Holt & Company, N.Y. 1900. \$1.00.

CHAPTER XI

- Atkinson: *Mushrooms: Edible and Poisonous*. Andrus & Church, Ithaca, N.Y. 1900. \$3.00.
- Gibson: *Our Edible Toadstools and Mushrooms*. Harper & Brothers, N.Y. \$7.50.
- Leavitt: *Outlines of Botany*, pp. 183-197.
- Marshall: *The Mushroom Book*. Doubleday, Page & Company, N.Y. 1901. \$3.00.
- Massee: *Text Book of Plant Diseases*. Macmillan Company, N.Y. 1899. \$1.60.
- McIlvaine: *One Thousand American Fungi*. 2d edition. The Bowen Merrill Company, Indianapolis. 1902. \$5.00.
- Ward: *Timber and Some of its Diseases*. Chaps. V, VI, VII, X-XIII.
- Year Book. 1894. *Grain Smuts: Their Cause and Prevention*, pp. 409-420.
- Report of the Department of Agriculture. 1885. *Twelve Edible Mushrooms of the United States*. (Reprinted as a Bulletin, 1890.)
- Report of the Secretary of Agriculture. 1890. *Mushrooms of the United States*, pp. 366-373.
- Year Book. 1897. *Some Edible and Poisonous Fungi*, pp. 453-470.
- Year Book. 1900. *Fungous Diseases of Forest Trees*, pp. 199-210.
- Cereal Rusts of the United States*. Bulletin No. 16. United States Department of Agriculture.
- How to grow Mushrooms*. Bulletin 53.
- Mushroom Poisoning*. Circular No. 13. Department of Agriculture.

BOOKS FOR GENERAL REFERENCE

1. Allen: The Story of the Plants. D. Appleton & Company, N.Y. 35 cents.
2. Bailey: New Encyclopedia of American Horticulture. The Macmillan Company, N.Y. 1900. 4 vols. \$20.00. (By subscription only.)
3. Bailey: Talks Afield. Houghton, Mifflin & Company, Boston. 1896. \$1.00.
4. Boyle: The Woodland's Orchids. Macmillan Company. 1901.
5. Campbell: The Evolution of Plants. Macmillan Company. 1899. \$1.00.
6. Crozier: A Dictionary of Botanical Terms. Henry Holt & Company, N.Y. 1892.
7. Darwin: The Power of Movement in Plants. D. Appleton & Company. 1886. \$2.00.
8. De Candolle: The Origin of Cultivated Plants. D. Appleton & Company. 1884. \$2.00.
9. Ganong: The Teaching Botanist. Macmillan Company. 1899. \$1.10.
10. Geddes: Chapters in Modern Botany. Charles Scribner's Sons, N.Y. 1893. \$1.25.
11. Gray: Structural Botany. American Book Company, N.Y. 1880. \$2.00.
12. Jackson: A Glossary of Botanic Terms. J. B. Lippincott Company, Philadelphia. 1900. \$2.00.
13. Kerner & Oliver: Natural History of Plants. Henry Holt & Company, N.Y. 1896. \$15.00.
14. Sorauer: A Popular Treatise on the Physiology of Plants. Longmans, Green & Company, London and N.Y. 1895. 9s. (about \$2.50).
15. Vines: Lectures on the Physiology of Plants. Macmillan Company. 1895. \$5.00.

Of the works named above, Nos. 2 and 13 are expensive and not likely to be accessible except in communities where there is a well-stocked public library. Kerner's work is written in a simple, popular style, and so profusely and beautifully illustrated as almost to explain itself without the text. No. 2, as its name implies, treats more particularly of botany in its practical relations to horticulture. No. 14 is a simple, practical treatise, easily understood, and as free from technicalities as the nature of the subject will permit.

No. 11 can be consulted with advantage. It is written in such a clear, intelligible style, and makes so plain the subjects with which it deals, that the student will find it very helpful.

HANDBOOKS

1. Britton: A Manual of the Flora of the Northern States and Canada. Henry Holt & Company, N.Y. 1898. \$2.25.
2. Britton & Brown: An Illustrated Flora of the Northern States and Canada. Charles Scribner's Sons, N.Y. 1898. 3 vols. \$9.00.
3. Chapman (A. W.): Flora of the Southern States. Revised ed. 1897. \$4.00.
4. Coulter: A Manual of the Botany of the Rocky Mountain Region. 1885. \$1.62.
5. Gray: Manual of the Botany of the Northern United States. 6th ed. Revised. 1890. \$1.62.
6. Gray: Field, Forest, and Garden Botany. New ed., revised by Bailey. 1895. \$1.44.
7. Willis: Practical Flora. 1894. \$1.50. 3-7 by the American Book Company.
8. Watson & Brewer: Botany of California. From the United States Geological Survey. 2 vols. 1875-1880. Has been republished by the State government of California, and will be found useful to students on the Pacific slope.

Teachers desiring to do only elementary work will find the Flora in Gray's little book, "How Plants Grow," a very convenient handbook. 80 cents.

For persons not sufficiently versed in Systematic Botany to use the manuals, a number of attractive guides have been prepared, some of which are named below: —

9. Apgar: Trees of the Northern United States. American Book Company. \$1.00.
10. Creevey: Flowers of Field, Hill, and Swamp. Harper & Brothers. 1897. \$1.75.
11. Keeler: Our Native Forest Trees. Charles Scribner's Sons. 1900. \$2.00.
12. Lounsberry (Alice): Southern Wild Flowers and Trees. Frederick A. Stokes & Company. 1901. \$3.75.
13. Matthews: Familiar Trees and Their Leaves. 1896. \$1.75.
14. Matthews: Familiar Flowers of Field and Garden. \$1.40. Both by D. Appleton & Company.
15. Field Book of American Wild Flowers. G. P. Putnam's Sons. 1902. \$1.75.
16. Newhall: The Trees of Northeastern America. 1891.
17. Newhall: The Shrubs of Northeastern America. 1893.
18. Newhall: The Vines of Northeastern America. 1897. \$1.75 each. 16-18 by G. P. Putnam's Sons, N.Y.

19. Parsons (Mrs. Dana) : How to know the Wild Flowers. Charles Scribner's Sons. 1897. \$2.00.
20. Wright : Flowers and Ferns in Their Native Haunts. Macmillan Company. 1901. \$2.00.

PERIODICALS

The science of Botany is advancing so rapidly that a book is very soon out of date, and one who wishes to keep abreast of the current of progress should have access to one or more of the standard periodical publications dealing with the subject. Some of the most available for general use are : —

- The Botanical Gazette, University of Chicago. Monthly. \$4.00.
Bulletin of the Torrey Botanical Club, Lancaster, Pa. \$2.00.
Forest Leaves. Pennsylvania Forestry Association, Philadelphia. Bi-monthly. \$1.00.
The Plant World. Binghamton, N.Y., and Washington, D.C. Bi-monthly. \$1.00.
Science. Lancaster, Pa., and Macmillan Company, N.Y. Weekly. \$5.00.
Rhodora. Published by the New England Botanical Club, Boston, Mass. Monthly. \$1.00.

INDEX

In the Index the numbers in Roman type (295) refer to sections: those in full-face type (39) refer to cuts.

- | | | | |
|-----------------------------|---------------|---------------------------|-------------------------|
| Aborted..... | 295, 313 | Ash..... | 196, 197 200 |
| Accessory buds..... | 263 | Assurgent..... | 202 |
| Accessory fruits..... | 111 | Asymmetrical..... | 291 |
| Acuminate leaf..... | 39 | Auricled..... | 37 |
| Acute leaf..... | 40 | Axial placenta..... | 109 |
| Adhesion..... | 303 | Axial root..... | 172 |
| Adjustment of leaves..... | 54-65 | Axil..... | 32, 50 |
| Adnate..... | 32, 284, 393 | Axillary buds..... | 241 |
| Adventitious buds..... | 178, 263 | Axis..... | 178, 246, 265, 266, 267 |
| Adventitious roots..... | 187 | Bacteria..... | 198, 385 |
| Æcidium..... | 403 | Bacteriology..... | 1 |
| Æcidium..... | 403 | Base..... | 36, 130 |
| Ærial roots..... | 186 | Basidia..... | 394 |
| Ærial stems..... | 201 | Bast..... | 219, 224 |
| Æstivation..... | 290 | Berry..... | 79 |
| Aggregate fruits..... | 112 | Biennial..... | 180 |
| Akene..... | 88 | Bilabiate..... | 308 |
| Albuminous..... | 125 | Black rust..... | 400 |
| Algæ..... | 357, 377-383 | Blade of leaf..... | 31 |
| Alternate leaves..... | 50 | Bract..... | 103 |
| Alternation of generations, | | Bryophytes..... | 358 |
| 364, 368, 370, 375 | | Bud..... | 241, 249-263 |
| Ament..... | 272 | Bud scales..... | 243 |
| Amentaceous..... | 311 | Bulb..... | 193 |
| Amphitropous..... | 226 | Button (of mushroom)..... | 389 |
| Anatomy of plants..... | 3 | Calyx..... | 74, 282, 309 |
| Anatropous..... | 131, 227 | Cambium..... | 220, 224 |
| Anemophilous..... | 332 | Campanulate..... | 422 |
| Angiosperms..... | 128 | Campylotropous..... | 131, 226 |
| Annals..... | 180 | Capitate..... | 295 |
| Annulus..... | 391 | Capsule..... | 93 |
| Anther..... | 284 | Carbohydrates..... | 26 |
| Antheridia..... | 366 | Carbon dioxide..... | 18, 24 |
| Apetalous..... | 304 | Carpels..... | 74, 103 |
| Apex..... | 36, 130 | Carpophore..... | 89 |
| Apetalous..... | 304, 305 | Caruncle..... | 123 |
| Appendage..... | 316, 317, 318 | Caryopsis..... | 91 |
| Arch of the hypocotyl..... | 153 | Catkin..... | 272 |
| Archegonia..... | 366 | Cedar apples..... | 406 |
| Aril..... | 317 | Cell..... | 9, 78, 287 |
| Ascending..... | 202 | | |
| Asexual generation..... | 368 | | |

- Cell sap 9, 213
 Central placenta 109
 Centrifugal drainage 58
 Centrifugal inflorescence 277
 Centripetal drainage 58
 Centripetal inflorescence 268
 Chalaza 121, 122, 123, 130
 Chlorophyll 25
 Circinate 261
 Circumscissile 108
 Claspig 34
 Cleistogamic flowers 314
 Climbing stems 203
 Clipped seed. . . (See page 90, *Material*)
 Cluster cups 403
 Cohesion 303
 Coiled inflorescence 278
 Collective fruits 113
 Color of flowers 338
 Compass plants 61
 Complete flower 291
 Compound leaf 45, 49
 Conduplicate 260
 Conjugation 381
 Conifers 225
 Connate 34
 Convolute 256, 290, 293
 Cordate 84
 Coriaceous 36
 Corky layer 219
 Corolla 282
 Cortex 174, 191
 Corymb 268
 Cotyledon 118, 121, 122
 Cremocarp 89
 Crenate 50
 Cross pollination 332
 Crown 316
 Cruciferae 295
 Cruciferous 295
 Cryptogam 359
 Culm 207
 Cuspidate 46
 Cycle of growth 158
 Cyme 276
 Cymose inflorescence 275
 Declined 202
 Decurrent 34, 393
 Definite annual growth 247
 Definite inflorescence 265
 Dehiscent fruits 83
 Deliquescent 240
 Deltoid 32
 Dentate 49
 Descriptive botany 6
 Desmids 382
 Determinate growth 247
 Determinate inflorescence 265
 Diadelphous 299
 Diatoms 382
 Dichotomous 246
 Dicotyledon 121-129
 Dimerous 302
 Dimorphic 331
 Dimorphism 331
 Dimorphous 331
 Diceious 311
 Dispersal of seed 133-136
 Distinct 303
 Dormant buds 262
 Dorsal 96
 Drainage (of leaves) 58
 Drupe 80
 Duct 214
 Ecology 5, 339
 Ecological factors 341
 Egg cell 327
 Emarginate 43, 44
 Embryo 118
 Embryology 329
 Embryo sac 327
 Endosmose 227
 Endosperm 118, 123, 125
 Entire 36
 Entomophilous 333
 Epidermis 174, 176, 191, 219
 Epigynous 294
 Equitant 34
 Essential constituents 197
 Essential organs 283
 Ex-albuminous 125
 Excentric attachment 391
 Excurrent 240
 Exogens 223
 Exosmose 227
 Extrorse 284
 Fall of the leaf 64
 False partition 101
 Fascicle 51
 Fascicled roots 171
 Feather-veined 38
 Fertile flower 310
 Fertilization 324, 327
 Fibrous roots 171
 Fibrovascular bundle 43, 215, 217, 224
 Filament, a hairlike appendage 293
 Filament of the stamen 284
 Filamentous algae 377, 379
 Fission 380
 Floral envelopes 282
 Follicle 94
 Free 289, 303, 393
 Free central placenta 109

Free veining.....	361	Inflexed.....	260
Fruit.....	73	Inflorescence.....	264
Function.....	8	Insectivorous plants.....	70, 71
Fungi.....	357, 384	Internode.....	50
Funiculus.....	75	Introrse.....	284
		Inverted seed.....	131
Gametes.....	367	Involucre.....	103
Gametophyte.....	367	Involute.....	261, 392
Gamopetalous.....	292	Irregular flower.....	291
Gamosepalous.....	292		
Gemmæ.....	373	Keel.....	298
Genus.....	411	Knots.....	239
Geophilous.....	352		
Geotropism.....	160	Lamina.....	70, 393
Germ.....	118	Lanceolate.....	27
Germ cell.....	327	Lateral buds.....	241
Germination.....	137-144	Leaf attachment.....	34
Gills (of mushroom).....	393	Leaf cups.....	59
Glabrous.....	36	Leaf scars.....	242
Glaucous.....	36	Leaf traces.....	219
Grain.....	91	Legume.....	96
Grain of timber.....	238	Lenticels.....	17, 219
Gravity.....	161	Ligulate.....	307
Growth.....	155	Life cycle.....	405
Gymnosperms.....	120, 127	Lobing.....	44
Gymnosporangium.....	406	Loculicidal.....	105
		Locus.....	78, 105, 287
Halophyte.....	348	Loment.....	100
Hastate.....	88	Lyrate.....	88
Haulm.....	207		
Haustoria.....	184	Medulla.....	219
Head.....	273	Medullary rays.....	174, 222
Heartwood.....	236	Megasporangia.....	370
Herbaceous.....	201	Megaspore.....	370
Heliotropism.....	57	Megasporophyll.....	370
Hilum.....	121, 130, 131	Mericarps.....	89
Histology.....	3	Metabolism.....	30
Horizontal seed.....	132	Mesophyte.....	348, 353
Host plant.....	184	Midrib.....	38
Hydrophytes.....	348, 349	Microsporangia.....	370
Hymenium.....	394	Microspore.....	370
Hymenomycetes.....	394	Microsporophyll.....	370
Hyphæ.....	388	Micropyle.....	120, 121, 130
Hypocotyl.....	118, 121	Monadelphous.....	299
Hypogynous.....	289	Monocarpellary.....	93
		Monocotyledons.....	119
Imbricated.....	250	Monœcious.....	311
Imperfect flower.....	291	Monopetalous.....	292
Incomplete flower.....	291	Monosepalous.....	292
Indefinite annual growth.....	247	Morphology.....	2
Indefinite inflorescence.....	265	Mosaic (leaf).....	55
Indefinite number of parts.....	266	Mucronate.....	47
Indehiscent fruit.....	84	Multiple fruit.....	113
Indeterminate growth.....	247	Mushroom.....	397
Indeterminate inflorescence.....	265, 266	Mycelium.....	388
Inoculum.....	302	Mycetes.....	388
Inferior ovary.....	289	Mycology.....	1

- Net-veined 37
 Neutral flower..... 310
 Node 50
 Nucleus... .. 9
 Numerical plan..... 288
 Nut..... 87

 Obcordate..... 45
 Oblique 36
 Obovate 30
 Obsolete 295
 Obtuse 41
 Oospore..... 367
 Opposite leaves..... 50
 Organ..... 8
 Organs of reproduction..... 151
 Organs of vegetation..... 151
 Orthotropous 130
 Osmose 227
 Oval 29
 Ovary 73, 285, 287
 Ovule..... 287

 Paleobotany 1
 Palmate veining 38
 Panicle..... 270
 Papilionaceous 298
 Pappus 88
 Parallel veining..... 37
 Paraphyses..... 394
 Parasitic plants 184
 Parenchyma..... 213
 Parietal 103
 Pedicel..... 264
 Peduncle 75, 103, 264
 Peltate 34
 Pentamerous 296, 302
 Pepo..... 78
 Perennial..... 181
 Perfect flower 291
 Perfoliolate 24
 Perianth..... 282
 Pericarp..... 74
 Perigynous 297
 Persistent 32
 Personate 308
 Petals..... 282
 Petiole..... 31, 33
 Phanerogams 355
 Photosynthesis..... 24
 Phyllotaxy..... 50-53
 Pileus..... 392
 Pinna..... 360
 Pinnate veining..... 38
 Pinnule 360
 Pistil 283, 285
 Pistillate 310
 Pitcher plant..... 70

 Pith 191, 219
 Placenta 75, 103, 287
 Plicate..... 124, 254
 Plumule..... 118, 121
 Pollen..... 284
 Pollen grains 284
 Pollen sac..... 284
 Pollen tubes..... 325
 Pollination 286
 Polycotyledons 120
 Polymorphic..... 407
 Polymorphism..... 386, 407, 408
 Polypetalous..... 304
 Pome 74
 Prefloration 290
 Prefoliation 254
 Primary root..... 170
 Pronuba 334
 Protection..... 72, 335
 Prothallium 366
 Protoplasm..... 9, 213
 Pteridophytes..... 359
 Pubescent..... 36
 Puccinia 400

 Raceme..... 267
 Rachis..... 45, 264
 Radial roots..... 172
 Radial section..... 237
 Raphe..... 122, 131
 Ray flowers 307
 Receptacle..... 74, 75, 103, 282
 Red rust..... 399
 Region of growth..... 148, 153, 157
 Regular flower..... 291
 Respiration..... 28
 Revolute..... 261, 392
 Rhizoids 372
 Rhizoma..... 189
 Ribs 39
 Ringent 308
 Rings of growth..... 221, 223, 224
 Root cap..... 150
 Root growth..... 148, 150, 153, 172
 Root hairs..... 149
 Root pressure 229
 Root pull..... 165
 Rootstock 188
 Rosette..... 55
 Rostelia..... 406
 Rotate..... 420
 Rudimentary organs..... 313
 Rugose 53
 Runcinate..... 68
 Runner 208

 Sagittate..... 35
 Salver-shaped..... 421

Samara	90	Suspended seed	132
Sap movement 226, 227, 231, 232, 233, 234		Suture	94, 98, 103
Saprophyte	185	Symbiosis	340
Sapwood	236	Symmetrical flower	291
Scale leaves	68	Symmetry	36, 291
Scape	193	Sympetalous	292, 304, 306
Scion	208	Syncarpous	103
Scorpioid inflorescence	278	Syngenesious	428
Secondary roots	170	Synsepalous	292
Seed vessel	73	Systematic botany	6
Sepals	74, 282		
Septa	106	Tangential section	237
Septicidal	106	Tap root	170
Septifragal	107	Taxonomy	6
Serrate	48	Tegmen	122, 123
Sessile	34	Teleutospore	401
Sexual generation	368	Tendril	32, 67, 203, 211
Silicle	102	Terete	207
Silique	101	Terminal bud	241
Sinuate	52	Testa	122, 123
Sleep movements	62, 63	Tetradynamous	295
Sori	362, 399	Tetramerous	295, 302
Spathe	292	Thallophytes	357
Spatulate	28	Thallus	357, 366, 371
Species	411	Tissue	10
Spermatophytes	126, 355	Toadstools	397
Spike	271	Torus	75, 282
Spine	32, 68, 209, 210	Trama	394
Spirogyra	379	Transformation of leaves	66-72
Sporangia	363	Transformation of organs	315, 320, 321
Spore	363, 364, 396	Transpiration	15
Spore print	395	Trifoliolate	46
Sporidia	402	Trimerous	288, 302
Sporophyll	370, 375	Trimorphic	331
Sporophyte	365	Truncate	36
Stamen	283, 284	Tuber	190
Staminate flower	310	Tunicated	194
Staminodia	315	Twining stems	203
Starch	26, 118, 119, 192, 200	Twining, cause of	162, 204
Stems	201-212		
Sterile flower	310	Umbel	269
Stigma	285	Undulate	51
Stigmatic surface	293	Unisexual	310
Stipe	360	Unsymmetrical	291
Stipe of mushroom	391	Urceolate	428
Stipule	31, 32	Uredo	399
Stolon	208	Uredospore	399
Stoma	16		
Stomata	16	Valvate	257
Stone fruit	80	Valves	99
Storage of food	125, 192, 196	Vascular bundles	43, 214, 217, 224
Style	285	Vascular cylinder	174
Suckers	208	Vascular cryptogams	359
Summer spores	401	Vascular system	214
Sundew	71	Vascular tissue	10, 191
Superior	289	Vegetable physiology	4
Supernumerary buds	263	Vegetative multiplication	380
Suppressed	295, 313	Veil	390

Veins.....	37-43	Water roots.....	183
Ventral.....	96	Whorled leaves.....	51
Vernation.....	254, 260, 261	Wind pollination.....	332
Versatile.....	284	Wings.....	59, 298
Verticel.....	51	Winter spores.....	401
Vexillum.....	298		
Viscid.....	36	Xerophyte.....	348
Vitality of seeds.....	142	Xerophyte societies.....	350
Vittæ.....	89		
Volva.....	390	Yellow trumpets.....	70
Water holders.....	59	Yucca moth.....	334

A BRIEF FLORA
OF THE
EASTERN UNITED STATES

BY
W. NEVIN GEDDES, A.M., PH.D.



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BRIEF FLORA E.U.S.

PREFACE

THE beginner in botany is embarrassed in the attempt to use a complete flora of the country, by the multitude and diversity of the plants it presents. The difficulties attaching to many of these plants, moreover, often lead to discouragement and a complete loss of interest in the study. An attempt to relieve this embarrassment and discouragement and to awaken increased interest has been made in the present work. It is a flora of the United States east of the one hundredth meridian, containing a description of such flowering plants, native, naturalized, and cultivated, as are most frequently met with and are most likely to be examined by a beginner. It embraces 91 families, 432 genera, and 1257 species.

The chief aim has been to describe each one of these included plants so exactly and fully as to enable the pupil to determine accurately its genus and species. Much has been said and written, and not without reason, in condemnation of botanical work which results in nothing more than the collection of so many dried plants marked with a few Latin names. One of the factors contributing to this lamentably barren result is unquestionably the embarrassment and discouragement already referred to, which this work is designed to remove. At the same time, there can be little doubt that the careful study of an unknown plant furnishes a useful exercise in observation, and the recognition of each item of its description in accurate botanical terms provides a valuable drill in language. The Latin name arrived at is an object only secondary to the main one, which is the acquisition of the ability to determine the identity of the plant examined with the species described. In other words, the main object is not the mere information gained, but the increase of ability to get information. The acquisition of a hundred Latin names is of comparatively little value, and can be secured, as it often has been, without any knowledge whatever of botany. But the acquaintance with these names, when acquired through careful botanical analysis, involves not only a knowledge of their relation to each other and to other plants, but also, what is of vastly more importance, a very excellent training of the power of accurate observation.

Material for the descriptions has been drawn from a great variety of sources, all of which have been more or less consulted and compared. At the same time, the information thus obtained has been subjected to the judgment acquired by the author of this work from a practical experience of many years in field, forest, and garden. The

leading authorities thus used have been Gray's "Synoptical Flora of North America," Gray's and Chapman's "Manuals," Britton and Brown's "Illustrated Flora of the Northern States and Canada," the flora of Wood's "Class Book of Botany," Small's "Flora of the South-eastern United States," Bailey's revised edition of "Gray's Field, Forest, and Garden Botany," Bailey's "Cyclopedia of American Horticulture," Nicholson's "Dictionary of Gardening," "The Treasury of Botany," and Warming's "Systematic Botany," besides a number of less comprehensive works, such as Alice Lounsberry's "Southern Wild Flowers and Trees" and her "Guide to the Trees," Harriet L. Keeler's "Our Native Trees" and "Our Northern Shrubs," Newhall's "Trees, Shrubs, and Vines of Northeastern America," and Apgar's "Trees of the Northern United States."

The order of arrangement of families has been in the main that of Wood's "Class Book of Botany," from which has been taken the analytical key to the families, with a few slight changes to adapt it to the differences of family names in the two floras. In the use of names for families, genera, and species, a conservative and eclectic principle has been followed, so that in some cases they will be found to agree with one, and in others with another, of the names given in the common American floras of Gray, Wood, Chapman, and Britton and Brown. In such cases the fact has usually been indicated by giving as synonyms the names used by the other floras. The full key to all the families, with proper references to other floras for the families not contained in this book, has been given in order that the pupil, when he encounters a plant of a family not included in this flora, may know where to look for it in a fuller one.

The manner of using it is as follows: The pupil, with the flower, leaves, and a part of the stem before him, reads the two lines beginning with Class I and Class II, and asks himself first to which of the two it belongs, the Exogens or the Endogens. This he determines by comparing his flower, leaves, and plant generally with the descriptions given immediately after those names. If he finds it under Class I, he then determines, in the same way, to which of the subclasses it belongs, the Angiosperms or the Gymnosperms, by reading the descriptions following those words. If he finds it in the Angiosperms, he then determines to which of the sections (§) it belongs,—Polypetalous plants, Gamopetalous plants, or Apetalous plants. If he finds it in the Polypetalous section, then he passes to that part of the key headed "§ I. Polypetalous plants," and then proceeds as follows: Reading the three lines preceded by the asterisk (*), he determines which one describes his plant. If the first, then he passes to the lines below numbered 11, and puts the query again as to which line describes his plant. And so he continues till he reaches the family, where the number will show to what part of the flora he is to turn. At this point he should compare his

plant with the description of the family. If the plant agrees with the description, he proceeds to determine the genus by the help of another partial key, if the family is large. If very small, of only one or two genera, he reads the description of the first genus, and if it agrees with the plant, he then proceeds by similar steps to determine the species.

In this connection it is suggested that the student have his attention directed, at a very early stage of the field work, to the distinctive marks of a few of the very large and easily recognized families. The Mints or Labiates, *e.g.*, with their square stems, opposite leaves, lipped corollas, diandrous or didynamous stamens, and four akenes, the Figworts, the Crucifers, the Umbellifers, the Composites, the Pea family, the Rose family, and several others almost as easily identified can quickly and with little effort be so mastered in their distinctive features that the young botanist may recognize them at sight as readily as the veteran. The writer makes this suggestion because he has often questioned young botanists who had gotten well along in their required quota of fifty or seventy-five plants, and found them totally ignorant on this point. Nothing will stimulate the interest of a beginner more certainly than the ability to locate his plant in its family at sight, and thus be able to turn to it at once without the aid of the key. At this point he realizes he is near the goal.

While the number of genera described in detail is only 432, it frequently happens that the key attached to a family will enable the pupil to determine others for whose species he will be referred to fuller floras. In the Coniferæ, *e.g.*, the key under that family gives the distinctive marks of all the genera found in our territory, so that a pine may be distinguished from a hemlock, spruce, cedar, etc.

It is hoped that this brief flora will serve its purpose and prove sufficient through all the preliminary school study. The botanist who pursues the subject for a lifetime and takes in the entire flora of the country will, of course, need a complete manual; the beginner needs only such a one as this, embracing merely the plants he is likely to undertake.

ABBREVIATIONS OF NAMES OF AUTHORS CITED FOR PLANT NAMES

Adans. Adanson.	Gron. Gronovius.	Raf. Rafinesque.
A. DC. Alphonse De Candolle.	Hack. Hackel.	Reich. Reichenbach.
Ait. Aiton, William.	Haw. Haworth.	Rich. Richardson.
Arn. Arnott, G. A. Walker.	HBK. Humboldt, Bonpland, and Kunth.	Roem. Roemer.
Aubl. Aublet.	Herb. Herbert.	Roxb. Roxburgh.
Aust. Austin.	Hoffm. Hoffmann.	Rutz. & Pav. Ruiz Lopez and Pavon.
Baill. Baillon.	Hook. Hooker.	Salsb. Sallsbury.
Baldw. Baldwin.	Hort. Horticultural or Florist name.	Schrad. Schrader.
Bart. Barton.	Huds. Hudson.	Schreb. Schreber.
Bartr. Bartram.	Jacq. Jacquin.	Schult. Schultz.
Beauv. Beauvois.	Juss. Jussieu.	Schw. or Schwein. Schwein- nitz.
Benth. Bentham.	L. or Linn. Linnaeus.	Scop. Scopoli.
Beuth. & Hook. Bentham and Hooker.	Lam. Lamarck.	Scribn. Scribner.
Bigel. or Big. Bigelow.	Lamb. Lambert.	Ser. Seringe.
Boehm. Boehmer.	Lehm. Lehmann.	Sibth. Sibthorp.
Boiss. Boissier.	Less. Lessing.	Sieb. & Zucc. Siebold and Zuccarini.
Borkh. Borkhausen.	L'Her. L'Heritier.	Sm. Smith.
Br. R. Robert Brown.	Lind. Lindley.	Soland. Solander.
Brongn. Brongniart.	Lk. Link.	Spreng. Sprengel.
Buckl. Buckley.	Loisel. Loiseleur-Deslong- champs.	Steph. Stepani.
Cass. Cassini.	Lour. Loureiro.	Steud. Steudel.
Cav. Cavanilles.	Marsh. Marshall.	St. Hil. Saint Hilaire.
Cham. Chamisso.	Mart. Martens.	Sulliv. Sullivan.
Chapm. Chapman.	Maxim. Maximowicz.	Sw. Swartz.
Chols. Cholsy.	Medic. Medicus.	Thun. Thunberg.
Darl. Darlington.	Meisn. Meisner.	Thur. Thurber.
DC. De Candolle.	Mentz. Mentzel.	Torr. Torrey.
Decne. Decaisne.	Michx. or Mx. Michaux.	Torr. & Gr. or T. & G. Tor- rey and Gray.
Desf. Desfontaines.	Mill. Miller.	Tourn. Tournefort.
Desv. Desvaux.	Miq. Miquel.	Traut. Trautvetter.
Dew. Dewey.	Muhl. Muhlenberg.	Tuckerm. Tuckerman.
Dicks. Dickson.	Murr. Murray.	Vaill. Vaillant.
Dill. Dillenius.	Naud. Naudin.	Vent. Ventenat.
Dufr. Dufresne.	Neck. Necker.	Vill. Villars.
Dumort. Dumortier.	Nutt. Nuttall.	Wahl. Wahlenberg.
Eat. Eaton.	Pall. Pallas.	Walt. Walter.
Ehrh. Ehrhart.	Pav. Pavon.	Wang. Waagenheim.
Ell. Elliott.	Pers. Persoon.	Wendl. Wendland.
Endl. Endlicher.	Ph. Pursh.	Wigg. Wiggers.
Engelm. Engelmann.	Planch. Planchon.	Willd. Willdenow.
Esch. Eschscholtz.	Plum. Plummer.	Wils. Wilson.
Foug. Fougereux.	Poir. Poiret.	With. Withering.
Gaertn. Gaertner.	Poll. Pollich.	Wulf. Wulfen.
Gmel. Gmelin.	R. Br. Robert Brown.	
Grev. Greville.		
Gris. or Griseb. Grisebach.		

SIGNS

The degree sign (°) is used for feet, the minute sign (') for inches, and the second sign (") for lines or twelfths of an inch. The interrogation point (?) indicates doubt, and the exclamation point (!) authentication from personal observation. In the marks for accent, the acute accent (') indicates the short English sound of the vowel, and the grave (`) the long English sound.

KEY TO THE NATURAL ORDERS

N.B. — Only those orders followed by numbers are here given. For those followed by an asterisk (*), consult fuller floras of Gray, Wood, Britton, or Chapman.

CLASSES, SUBCLASSES, AND SECTIONS

CLASS I. EXOGENS or DICOTYLEDONS. Leaves net-veined. Parts of flowers never completely in 3's, but mostly in 4's and 5's. Wood, if any, in annual rings. Embryo with 2 or more cotyledons.

SUBCLASS I. ANGIOSPERMS. *Ovules and seeds inclosed* in the pistils and fruit respectively. Embryo with 2 cotyledons.

§ I. **Polypetalous plants.** *Calyx and corolla both present, and petals distinct.*

§ II. **Gamopetalous plants.** *Calyx and corolla both present, and petals united.*

§ III. **Apetalous plants.** *Corolla absent, and sometimes also the calyx.*

SUBCLASS II. GYMNASPERMS. *Ovules and seeds naked*, on an open scale. Embryo with 2 or more cotyledons. See page 321.

§ IV. **Coniferous plants.** Stems branching, woody, jointless.

CLASS II. ENDOGENS or MONOCOTYLEDONS. Leaves parallel-veined, rarely net-veined. Parts of flowers in 3's. Wood, if any, not in annual rings, but mingled with pith and bark. *Embryo with only one cotyledon. Almost entirely herbs in temperate regions.*

§ V. **Spadiceous plants.** Flowers on a spadix.

§ VI. **Petaloidous plants.** Flowers not on a spadix. Perianth of 2 whorls, the inner often petaloid.

§ VII. **Glumaceous plants.** Flowers without proper perianth, but inclosed in chaff-like bracts or glumes, as in Sedges and Grasses.

§ I. Polypetalous Plants

* Herbs with the leaves alternate or all radical. (11)

* Herbs with the leaves opposite on the stem. (7)

* Shrubs, trees, or undershrubs. — Flowers regular or nearly so. (3)

— Flowers irregular (or fruit a legume). (r)

2. Polyandrous, — stamens 3 to 10 times as many as the petals, or more. (8)

2. Oligandrous, — stamens 1 to 2 times as many as the petals, or fewer. (4)

3. Leaves opposite. (s)

3. Leaves alternate. — Stamens on the torus or the hypogynous corolla. (t)

— Stamens and petals on the calyx tube. (v)

4. Ovaries simple, distinct or solitary. Vines or erect shrubs. (w)
 4. Ovary compound, — wholly adherent to the calyx. (x)
 — free from the calyx or nearly so. (y)
 5. Stamens opposite to the petals and of the same number. (y)
 5. Stamens alternate with the petals or of a different number. (6)
 6. Leaves opposite on the stems. (z)
 6. Leaves alternate, — compound. (yy)
 — simple. (zz)
 7. Polyandrous, — stamens 8 to 10 times as many as the petals, or more. (m)
 7. Oligandrous, — stamens 1 to 2 times as many as the petals, or fewer. (8)
 8. Pistils separate and distinct, few or solitary, simple. (n)
 8. Pistils united, — ovary compound, free from the calyx. (9)
 — ovary compound, adherent to the calyx. (o)
 9. Stamens opposite to the petals and of the same number. (p)
 9. Stamens alternate with the petals or of a greater number. (q)
 11. Flowers regular or nearly so. Fruit never a legume. (18)
 11. Flowers irregular (rarely regular) and the fruit a legume. (12)
 12. Stamens numerous, 8 or more as many as the petals. (k)
 12. Stamens few and definite, 5 to 12.
 13. Stamens 8 to 10 times as many as the petals. (15)
 13. Stamens few and definite. — Ovary free from the calyx. (14)
 — Ovary adherent to the calyx. (j)
 14. Pistils *one*, or indefinite (1 to 15), distinct, simple. (e)
 14. Pistils definitely — 2 united, the short styles combined into *one*. (f)
 — 3 or 4 united, styles or stigmas 3, 4, or 6. (g)
 — 5, distinct or united, with 5 distinct styles. (h)
 — 5 united and the styles combined *one*. (i)
 15. Stamens hypogynous, — on the receptacle. (16)
 15. Stamens perigynous, — on the corolla at the base. (c)
 — on the calyx at the base. (d)
 16. Pistils few or many, distinct (at least as to the styles). (a)
 16. Pistils (and styles if any) completely united. (b)
 a. Petals 5 or more, deciduous. Leaves not peltate. **RANUNCULACEÆ** 1
 a. Petals 8, persistent, withering. Floating leaves peltate. **CABOMBACEÆ** *
 a. Petals numerous, deciduous. Leaves all peltate. **NYMPHÆACEÆ** 6
 b. Sepals 4 to 6, equal. Petals many, imbricated in bud. **NYMPHÆACEÆ** 6
 b. Sepals 5, equal. Petals 5, imbricate. Leaves tubular. **SARRACENIACEÆ** 6
 b. Sepals 5, unequal. Petals 5, convolute. Flowers of 2 sorts. **CISTACEÆ** 15
 b. Sepals 2, with — 5 petals imbricated in the bud. **PORTULACACEÆ** 15
 — 4 or 8 petals usually crumpled in the bud. **PAPAVERACEÆ** 8
 c. Filaments united into a tube. Anther 1-celled. **MALVACEÆ** 18
 d. Sepals 2, persistent, capping the pod. **PORTULACACEÆ** 15
 d. Sepals 8 to 5, valvate in the bud. Pod long, 2-carpeled. **TILIACEÆ** 19
 d. Sepals 8 to 5. — Petals imbricate in bud. Fruit simple. **ROSACEÆ** 36
 — Petals convolute in bud. Fruit compound. **LOASACEÆ** *
 e. Stamens opposite to the imbricated petals. Pistil 1 only. **BERBERIDACEÆ** 5
 e. Stamens alternate with the petals or more numerous. **RANUNCULACEÆ** 1
 f. Stamens 6 (tetradynamous). Pods 2-celled. **CRUCIFERÆ** 10
 f. Stamens 4, or 8 to 32. Pod 1-celled. **CAPPARIDACEÆ** 11
 g. Sepals and petals in 8's. Stamens 6. Small herb. **LIMNANTHACEÆ** *
 g. Sepals and petals in 4's. Stamens 8. Climbing. **SAPINDACEÆ** 32
 g. Sepals, etc., in 5's. — Stam. 5, monadelphous. Climbing. **PASSIFLORACEÆ** 43
 — Stam. 5, distinct. Yellow. Erect. **TURNERACEÆ** *
 — Stam. 5, distinct. Cyanic. Erect. **DROSERACEÆ** 40
 — Stam. 8 to 15. — Fls. perfect, many, minute. **CISTACEÆ** 12
 — Fls. monœcious. **EUPHORBACEÆ** *
 h. Stamens 5, alternate with the 5 petals. Seeds numerous. **LINACEÆ** 20
 h. Stamens 5, opposite to the 5 petals. Seed 1. **PLUMBAGINACEÆ** *
 h. Stamens 10, the filaments united at the base. **OXALIDACEÆ** 23
 h. Stamens 6 to 24 (twice as many as the petals), distinct. **CRASSULACEÆ** 39
 i. Ovary 1-celled. Leaves radical, irritable. **DROSERACEÆ** 40
 l. Ovary 2 to 5-celled. — Leaves dotless, mostly radical. **ERICACEÆ** 57
 — Leaves dotted. Cauline, pinnate. **RUTACEÆ** 25

- j. Styles 5 or more. Ovary 1-celled, half-adherent. Sepals 2 **PORTULACACEÆ** 15
 j. Style 1, carpels as many as the petals (2 to 6) . . . **ONAGRACEÆ** 42
 j. Styles 2, carpels 2, fewer than the (5) petals. Seeds several **SAXIFRAGACEÆ** 38
 j. Styles 2, carpels 2, fewer than the (5) petals. Seeds 2 . . . **UMBELLIFERÆ** 47
 j. Styles 3 to 5, ovary 3 to 5-celled, 3 to 5-seeded . . . **ARALIACEÆ** 48
 k. Ovaries many, or few, rarely 1, always simple . . . **RANUNCULACEÆ** 1
 k. Ovary compound, 8-carpeled, open before ripe . . . **RESEDACEÆ** *
 l. Sepals 2. Petals 4 (3 pairs). Spurs 1 to 2, blunt **FUMARIACEÆ** 9
 l. Sepals 5, very unequal. Petals 3. Stamens 6 to 8. No spur **POLYGALACEÆ** 34
 l. Sepals 4, petals 2, all colored alike. Spur slender . . . **BALSAMINACEÆ** 28
 l. Sepals and petals each — 4, not very irregular. No spur **CAPPARIDACEÆ** 11
 — 5. Stamens 8. Spur slender . . . **TROPÆOLACEÆ** 24
 — 5. Stamens 5. Spur blunt or none . . . **VIOLACEÆ** 18
 — 5. Stam. 10 (or more). Fr. a legume **LEGUMINOSÆ** 35
 m. Pistils many, entirely distinct, simple . . . **RANUNCULACEÆ** 1
 m. Pistils 3 to 5, united more or less completely . . . **HYPERICACEÆ** 16
 m. Pistils 5 to 10, united, with sessile stigmas and many petals **MESEMBRYACEÆ** *
 n. Pistil solitary, simple. Petals 6 to 9. Stamens 12 to 18 **BERBERIDACEÆ** 5
 n. Pistils 3 or more, distinct, simple. Fls. all symmetrical **CRASSULACEÆ** 39
 n. Pistils 2, consolidated with the 5 stamens. Juice milky **ASCLEPIADACEÆ** 74
 o. Carpels as many as the sepals. Anthers open at the top **MELASTOMACEÆ** *
 o. Carpels as many as the sepals. Anthers open laterally . . . **ONAGRACEÆ** 42
 o. Carpels fewer than the sepals, — many-seeded. Styles 2 **SAXIFRAGACEÆ** 38
 — 1-seeded. Styles 2 or 3 . . . **ARALIACEÆ** 48
 — 1-seeded. Style 1 (double) . . . **CORNACEÆ** 49
 p. Style 3-cleft at the summit . . . **PORTULACACEÆ** 15
 p. Style and stigma 1, undivided . . . **PRIMULACEÆ** 58
 q. Leaves pinnate, with interpetiolar stipules . . . **ZYGOPHYLLACEÆ** *
 q. Leaves simple, toothed or lobed. Flowers cruciform. Stamens 6 **CRUCIFERÆ** 10
 q. Leaves simple, toothed or lobed. Flowers 5-merous. Stam. 10 **GERANIACEÆ** 21
 q. Leaves simple, entire. (qq)
 qq. Petals and stamens on the throat of the calyx . . . **LYTHRACEÆ** *
 qq. Pet. hypogynous. — Fls. irregular, unsymmetrical . . . **POLYGALACEÆ** 34
 — Fls. regular — 2 (or 3)-parted throughout **ELATINACEÆ** *
 — 5-parted. — Lvs. punctate **HYPERICACEÆ** 16
 — Lvs. dotless **CARYOPHYLLACEÆ** 14
 r. Pistil a simple carpel, becoming a legume. Stamens 10 to 100 **LEGUMINOSÆ** 35
 r. Pistil compound, — 8-carpeled. Fls. perfect. Lvs. digitate. **SAPINDACEÆ** 32
 — 8-carpeled. Fls. monocious. Cultivated **BEGONIACEÆ** 45
 — 5-carpeled. — Stipules present. Cultivated **GERANIACEÆ** 21
 — Stipules none. Native . . . **ERICACEÆ** 57
 s. Stamens on the receptacle, in several sets. Leaves dotted . . . **HYPERICACEÆ** 16
 s. Stamens on calyx. — Ovaries many, free, but inclosed **CALYCANACEÆ** 37
 — Ov. compound, free in the bell-shaped cal. **LYTHRACEÆ** *
 — Ov. adherent. — Fruit fleshy, baccate . . . **MYRTACEÆ** *
 — Fruit dry, capsular **SAXIFRAGACEÆ** 38
 t. Petals imbricate or valvate in aestivation. (u)
 t. Pet. convolute. — Anthers 1-celled, turned inward . . . **MALVACEÆ** 18
 — Anthers 2-celled, turned outward. Exotic **STEBULIACEÆ** *
 u. Ovaries distinct. Petals 6, valvate. Erect shrubs . . . **ANONACEÆ** 3
 u. Ov. distinct. Petals 3 to 9, imbricate. Trees or erect shrubs **MAGNOLIACEÆ** 2
 u. Ov. distinct, few. Pet. 6 to 9, imbricate. Climbing shrubs **MENISPERMACEÆ** 4
 u. Ov. compound. — Leaves punctate with pellucid dots . . . **AURANTIACEÆ** *
 — Lvs. opaque. — Sepals valvate. Flowers small. **TILLACEÆ** 19
 — Sep. imbricate. Fls. large **TERNSTROMIACEÆ** 17
 v. Style 1 with many stigmas. Green, fleshy shrubs . . . **CACTACEÆ** 46
 v. Styles several, or 1 with 1 stigma. Woody trees or shrubs . . . **ROSACEÆ** 36
 w. Pistils many, apiculate on the slender torus. Climbing . . . **SCHIZANDRACEÆ** *
 w. Pistils 2 to 6, capitate on the short torus. Climbing . . . **MENISPERMACEÆ** 4
 w. Pistil 1 only. Fls. 6-parted. Stam. opposite the petals **BERBERIDACEÆ** 5
 x. Flowers 4-parted. Stamens 8. Flowers red or roseate . . . **ONAGRACEÆ** 42
 x. Flowers 4-parted. Stamens 4. Flowers whitish . . . **CORNACEÆ** 49
 x. Flowers 5-parted. — Ovary 5-carpeled, 5-styled . . . **ARALIACEÆ** 48
 — Ovary 2-carpeled . . . **SAXIFRAGACEÆ** 38

- y. Leaves opposite, stem climbing with tendrils . . . **VITACEÆ** 81
 y. Leaves alternate. Erect, or vine without tendrils . . . **RHAMNACEÆ** 80
 z. Carpels 3 to 5, styles short. Leaves simple . . . **CELASTRACEÆ** 29
 z. Carpels 3, styles long, slender. Leaves pinnate, serrate . . . **SAPINDACEÆ** 82
 z. Carpels 2, with 2 slender styles. Samara double . . . **SAPINDACEÆ** 82
 z. Carpels 1 to 2, with 1 short style. (Drupe or single samara.) . . . **OLEACEÆ** 75
 yy. Filaments 10, united into a tube. Leaves bipinnate . . . **MELIACEÆ** 37
 yy. Fls. 5, distinct. — Leaves pellucid punctate . . . **RUTACEÆ** 25
 — Lvs. opaque. — Ov. 3-carpeled, 1-seeded . . . **ANACARDIACEÆ** 88
 — Ov. of 8 1-seeded carpels . . . **SAPINDACEÆ** 83
 zz. Petals 4, yellow. Ovary 2-carpeled, 2-seeded . . . **HAMAMELIDACEÆ** 41
 zz. Pet. 4 to 7, cyanic. — Drupe 1-seeded, but with 8 stigmas . . . **ANACARDIACEÆ** 88
 — Drupe 4 to 6-seeded, stigmas 4 to 6 . . . **ILICACEÆ** 28
 — Cap. many-seeded **ERICINEÆ**, 57. **PITTOSPORACEÆ** *
 — Capsule 3-seeded (scarlet). Seeds ariled **CELASTRACEÆ** 29
 — Capsule 3 to 8-seeded. Ovules pendulous. § II. **ERICACEÆ** 57

§ II. Gamopetalous Plants

- § Stamens (6 to many) more numerous than the lobes of the corolla. (a)
 § Stamens (2 to 12) fewer than the corolla lobes or of the same number. (a*)
 *2. Ovary inferior, adherent to the tube of the calyx. (3)
 3. Stamens cohering by their anthers. (c)
 3. Stamens entirely distinct. (d)
 *2. Ovary superior, free from the tube of the calyx. (6)
 6. Flowers regular and the stamens symmetrical. (7)
 7. Stamens opposite to the lobes of the corolla (and free). (e)
 7. Stamens alternate with the corolla lobes (rarely connate). (9)
 9. Shrubs, trees, with the carpels or stigmas 3 to 6. (f)
 9. Herbs 1 to 10-carpeled, or shrubs 2-carpeled. (g)
 6. Flowers regular and the stamens reduced to 2. (n)
 6. Flowers irregular. Stam. (except in 3 or 4 species) unsymmetrical. (o)
 a. Filaments 6, united into 2 equal sets. Herbs . . . **FUMARIACEÆ** 9
 a. Filaments numerous, united into 1 tube inclosing the styles . . . **MALVACEÆ** 18
 a. Filaments 10, united into a split tube around the 1 style . . . **LEGUMINOSÆ** 85
 a. Filaments numerous, united only at the base into 1 or 5 sets. (b)
 b. Calyx of 5 leafy imbricated sepals. Shrubs, trees **TERNSTROEMIACEÆ** 17
 b. Calyx tubular, 5-toothed or truncate. Shrubs, trees **STYRACACEÆ** *
 a. Filam. entirely distinct. — 8 or 10 in number. Flowers perfect **ERICACEÆ** 57
 — 8 and 16 in number. Fls. polygamous **EBENACEÆ** *
 c. Flowers in a compact head surrounded by an involucre **COMPOSITÆ** 54
 c. Flowers separate, irregular, perfect. Plants erect . . . **LOBELIACEÆ** 55
 c. Flowers separate, regular, imperfect. Weak vines **CUCURBITACEÆ** 44
 d. Leaves alternate. Flowers 5-parted, regular, separate **CAMPANULACEÆ** 56
 d. Leaves opposite, with stipules between, or verticillate . . . **RUBIACEÆ** 51
 d. Lvs. opp. Stipules none. — Stam. 5 to 4. Ov. 2 to 5-celled **CAPRIFOLIACEÆ** 50
 — Stam. 2 to 3. Ov. 1-celled . . . **VALERIANACEÆ** 52
 — Stam. 4. Flowers in heads . . . **DIPSACEÆ** 58
 e. Herbs. Ovary with 5 styles and but 1 seed . . . **PLUMBAGINACEÆ** *
 e. Herbs. Ovary with 1 style and many seeds . . . **PRIMULACEÆ** 58
 e. Trees or shrubs. Ovary 1-styled, 5-celled, 1-seeded . . . **SAPOTACEÆ** *
 f. Style none. Drupe 4 to 6-seeded . . . **ILICACEÆ** 28
 f. Style one. Drupe 4-seeded . . . **VERBENACEÆ** 65
 f. Style one. Capsule 3 to 5-celled, many-seeded . . . **ERICACEÆ** 57
 g. Ovary deeply 4-parted, forming 4 akenia . . . **BORRAGINACEÆ** 67
 g. Ovaries 2, distinct (often covered by the stamens). (h)
 g. Ovary 1, compound, 1-celled (placenta often large). (k)
 g. Ovary 1, compound, 2 to 6-celled. (m)
 h. Stigmas connate. Flower bud convolute . . . **APOCYNACEÆ** 78
 h. Stigmas connate. Flower bud valvate ? . . . **ASCLEPIADACEÆ** 74
 h. Stigmas distinct. Flowers minute, yellow . . . **CONVOLVULACEÆ** 70

k. Ovule solitary. Corolla limb entire	NYCTAGINACEÆ	68
k. Ovules several. Leaves cleft and lobed	HYDROPHYLLACEÆ	68
k. Ovules several. Leaves or leaflets entire. — Fls. not spicate	GENTIANACEÆ	72
— Fls. spicate	PLANTAGINACEÆ	59
m. Leaves all radical. Flowers spiked	PLANTAGINACEÆ	59
m. Leaves opposite. — Ovary 2-celled	LOGANIACEÆ	61
— Ovary 8-celled. Not twining }	POLEMONIACEÆ	69
m. Leaves alternate — Ovary 8-celled. Not twining {		
— Ovary 2-celled. Twining	CONVOLVULACEÆ	70
— Ovary 2-celled, 4-seeded. Erect	BORRAGINACEÆ	67
— Ov. 2-celled, many-seeded. — Styles 2	HYDROPHYL	68
— Style 1	SOLANACEÆ	71
n. Shrubs. Corolla 5-parted, imbricated in bud	OLEACEÆ	75
n. Shrubs. Corolla 4-parted, valvate, or none	OLEACEÆ	75
o. Ovary deeply 4-parted, forming 4 (or fewer) akenia. (p)		
o. Ovary entire, 4-ovuled, 4 or fewer-seeded. Leaves opposite	VERBENACEÆ	65
o. Ovary entire, many-ovuled, many or several-seeded. (a)		
p. Leaves opposite. Stems square. Stamens 2 to 4	LABIATÆ	66
p. Leaves alternate. Stems round. Stamens 5	BORRAGINACEÆ	67
s. Trees or climbing shrubs. Seeds winged	BIGNONIACEÆ	60
s. Trees. Seeds not winged. SCROPH. 62. Erect shrubs	ERICACEÆ	57
s. Herbs. — Leafless parasites	OROBANCHACEÆ	6
— Leaves at base. Fruit 1-celled. Fls. spurred	LENTIBULACEÆ	63
— Leafy. — Fruit 4 to 5-celled. Leaves opposite	PEDALIACEÆ	6
— Fruit 2-celled. (t)		
t. Corolla convolute in bud. Seeds exalbuminous	ACANTHACEÆ	64
t. Corolla imbricate in bud. Seeds albuminous	SCROPHULARIACEÆ	62
t. Corolla plicate in bud. Seeds albuminous	SOLANACEÆ	71

§ III. Apetalous Plants

- † Plants herbaceous, the flowers not in aments (except in *Humulus*, the Hop). (3)
- † Plants woody, — shrubs or trees. (5)
3. Flowers with a regular calyx (or a calyx-like involucre). (3)
2. Flowers achlamydeous, — neither calyx nor corolla. (f)
3. Calyx tube adherent to the ovary, limb lobed, toothed, or entire. (a)
3. Calyx free from the ovary, sometimes inclosing it. (4)
4. Ovs. several, entirely distinct, each 1-styled, 1-ov. RANUNCULACEÆ 1
4. Ovary one, 1-ovuled, 1-seeded, style or stigma 1. (b)
4. Ovary one, 1 to 3-ovuled, with 2 to 5 styles or stigmas. (c)
4. Ovary one, with many ovules and 1 style or stigma. (d)
4. Ovary one, with 4 to many ovules and 2 to 12 styles or stigmas. (e)
- a. Stamens 1 to 3, symmetrical with the stigmas ONAGRACEÆ 42
- a. Stamens 8 to 10, the stigmas 2. Ovary many-seeded SAXIFRAGACEÆ 33
- a. Stamens 6 or 12, symmetrical with the 6 ovary cells ARISTOLOCHIACEÆ *
- a. Stamens 5, the style 1. Ovary 2-ovuled, 1-seeded SANTALACEÆ *
- b. Flowers perfect. Calyx 4-lobed, stamens 1 to 4 ROSACEÆ 36
- b. Flowers perfect. Calyx entire, funnel-shaped, colored NYCTAGINACEÆ *
- b. Flowers unisexual. Calyx 4 to 5-parted, green URTICACEÆ *
- c. Fruit 3-seeded, with 3 (often cleft) stigmas EUPHORBACEÆ *
- c. Fruit 1-seeded. — Stipules sheathing the stems POLYGONACEÆ 76
- Stipules 0. Calyx scarious-bracted AMARANTACEÆ *
- Stipules 0. Calyx double. Climbing BASELLACEÆ *
- Stip. 0. Calyx naked. Lvs. alternate CHENOPODIACEÆ *
- Stipules 0. Calyx naked. Leaves opposite. Scleranthus in. CARYOPHYLLACEÆ 14
- d. Stamens (4) opposite the sepals LYTHRACEÆ *
- d. Stamens (5) alternate with the sepals PRIMULACEÆ 58
- e. Leaves opposite. Fruit circumscissile (utricle) PORTULACACEÆ 15
- e. Leaves opposite. Fruit 4 to 5-valved (capsule) CARYOPHYLLACEÆ 14
- e. Leaves alternate. — Fruit 5-horned, 5-celled (capsule) CRASSULACEÆ 39
- Fruit a fleshy 4 to 10-seeded berry PHYTOLACCACEÆ 77
- Fruit circumscissile (utricle) AMARANTACEÆ *

- f. Flowers on a spadix with a spathe. Monocotyledons . . . **ARACEÆ** 80
 f. Flowers in a long naked spike. Stamens 6 or 7 . . . **SAURURACEÆ** *
- f. Flowers solitary, axillary, minute. Aquatic plants. (g) . . . **CALLITRICHACEÆ** *
- g. Stamens 1, styles 2. Leaves opposite . . . **CALLITRICHACEÆ** *
- g. Stamens 2, styles 2. Leaves alternate, dissected . . . **PODOSTEMIACEÆ** *
- g. Stamens 12 to 24, style 1. Lvs. verticillate, dissected **CERATOPHYLLACEÆ** *
5. Flowers not in aments, with the leaves opposite. (h) . . .
5. Flowers not in aments, with the leaves alternate. (k) . . .
5. Flowers (unisexual), the sterile only, in aments. (n) . . .
5. Flowers (unisexual), both the fertile and sterile in aments. (o)
- h. Fruit a double samara (2-winged) . . . **SAPINDACEÆ** 82
- h. Fruit a single samara (1-winged), or a drupe . Stamens 2 **OLEACEÆ** 75
- h. Fruit not winged, — 8-seeded. Stamens 4 . . . **EUPHORBIACEÆ** *
- 1-seeded. Stamens 4 or 8 . . . **ELÆAGNACEÆ** *
- 1-seeded. Stamens 8. Parasites **LORANTHACEÆ** *
- k. Style or stigma one. Fruit 1-seeded. (m) . . .
- m. Calyx free from the ovary. — Anthers opening by valves . **LAURACEÆ** 78
- m. Calyx free from the ovary. — Anthers opening by slits **THYMELACEÆ** *
- m. Calyx adherent to the ovary. — Ovules 2 to 4. (Shrubs.) **SANTALACEÆ** *
- Ovule 1. (Trees.) . . . **CORNACEÆ** 49
- k. Styles or stigmas 2. — Stamens numerous . . . **HAMAMELIDACEÆ** 41
- Stamens as many as the calyx lobes . . . **ULMACEÆ** *
- k. Styles or stigmas 3 (rarely 2 to 4). — Fruit dry, 3-partible **EUPHORBIACEÆ** *
- Fruit a fleshy drupe . . . **RHAMNACEÆ** 80
- k. Styles or stigmas 6 to 9. Heath-like undershrubs . . . **EMPETRACEÆ** *
- k. Styles and ovaries 5, scarcely united. Leaves pinnate . . . **RUTACEÆ** 25
- n. Nut or nuts in a cup or involucre. Leaves simple. . . **CUPULIFERÆ** *
- n. Nut drupaceous, naked. Leaves pinnate . . . **JUGLANDACEÆ** *
- o. Fruit fleshy, aggregated (sorosis). Juice (or sap) milky **ARTOCARPACEÆ** *
- o. Fruit dry. Plants with a watery juice or sap. (p)
- p. Aments globular, racemed. Nutlets 2-celled, woolly **HAMAMELIDACEÆ** 41
- p. Aments globular, solitary. Nutlets 1-celled, 1-seeded . **PLATANACEÆ** *
- p. Aments cylindrical or oblong. (s) . . .
- s. Ovary 1-celled, 1-seeded. Fruit often fleshy . . . **MYRICACEÆ** *
- s. Ovary 2-celled, 2-ovuled, 1-seeded. Fruit often winged **BETULACEÆ** *
- s. Ovary many-ovuled, many-seeded. Seeds comous . . . **SALICACEÆ** *

§ IV. Coniferous Plants

Fertile flowers in cones, or solitary and drupe-like. Stems branching, woody, jointless
CONIFERÆ 79

§ V. Spadiceous Plants

- ¶ Trees or shrubs with palmi-cleft leaves all from one terminal bud, and a branching "spadix" from a spathe . . . **PALMACEÆ** *
- ¶ Herbs with simple, rarely ternate leaves. Spadix simple. (2) . . .
2. Plants frond-like, minute, floating loose on the water . . . **LEMNACEÆ** *
2. Plants with stem and leaves, rooting and fixed. (3) . . .
3. Spadix evident, in a spathe or on a scape . . . **ARACEÆ** 80
3. Spadix obscure or spike-like. Stems leafy. (4) . . .
4. Flowers with no perianth, densely spicate or capitate . **TYPHACEÆ** *
4. Flowers with a perianth or not. Plants submersed **NAIADACEÆ** *

§ VI. Petaloideous Plants

- ¶ Flowers (not on a spadix) in a small, dense, involucre head. (k) . . .
- ¶ Flowers (not on a spadix) solitary, racemed, spicate, etc. (8) . . .
3. Perianth tube adherent to the ovary wholly or partly. (a) . . .
3. Perianth free from the ovary. (4) . . .

4. Petals and sepals differently colored (except in *Medeola*, 85). (e)
4. Petals and sepals similarly colored. (e)
- a. Flowers dioecious or polygamous. Low, aquatic herbs **HYDROCHARIDACEÆ** #
- a. Flowers dioecious, 6-androus. Shrubby climbers . . . **DIOSCOREACEÆ** #
- a. Flowers perfect, — gynandrous (stamen on the pistil) . . . **ORCHIDACEÆ** #
- monandrous with half an anther . . . **MARANTACEÆ** #
- 3 to 6-androus. Stamens distinct. (b)
- b. Perianth woolly or mealy outside. Ovary half-free . . . **HÆMODOURACEÆ** #
- b. Perianth glabrous outside. — Stamens 3, anthers introrse **BURMANNIACEÆ** #
- Stamens 3, anthers extrorse . . . **IRIDACEÆ** 88
- Stamens 6 . . . **AMARYLLIDACEÆ** 83
- c. Carpels many, distinct, akenate in fruit . . . **ALISMACEÆ** 81
- c. Carpels 3, united, with the stigmas distinct or not. (d)
- d. Leaves verticillate in 1 or 2 whorls. Stigmas 3 . . . **TRILLIACEÆ** 85
- d. Leaves alternate. — Stigmas 3. Scurfy epiphytes . . . **BROMELIACEÆ** #
- Stigmas united into 1 . . . **COMMELINACEÆ** 89
- e. Leaves net-veined, dilated. — Flowers perfect, 4-parted **ROXBURGHACEÆ** #
- Flowers dioecious, 6-parted . . . **SMILACEÆ** 84
- e. Leaves parallel-veined. (f)
- f. Styles, and often the stigmas also united into 1. (g)
- g. Flowers colored, regular. Stamens 6 (4 in 1 species) . . . **LILIACEÆ** 86
- g. Flowers colored, irregular or else triandrous . . . **PONTEDERIACEÆ** 88
- g. Flowers greenish, glume-like or scarious . . . **JUNCACEÆ** #
- f. Styles and stigmas 3, distinct. (h)
- h. Leaves rush-like. Ovary of 3 one-seeded carpels . . . **JUNCAGINACEÆ** #
- h. Leaves linear, lanceolate, etc. Ovary 6 to many-seeded **MELANTHACEÆ** 87
- k. Petals yellow, small but showy. Plant acaulescent . . . **XYRIDACEÆ** #
- k. Petals white, minute, fringed. Plant acaulescent . . . **ERIOCAULONACEÆ** #

§ VII. Glumaceous Plants

- † Flower with a single bract (glume). Culm solid, sheaths entire . . . **CYPERACEÆ** 90
- † Flower with several bracts (glumes and pales). Culm hollow. Sheaths split on one side . . . **GRAMINEÆ** 91

§ I. POLYPETALOUS PLANTS. — ANGIOSPERMOUS EXOGENS

ORDER 1. RANUNCULACEÆ — CROWFOOT FAMILY

Herbs, rarely shrubs or woody vines, with watery, usually bitter or acrid juice. Leaves alternate or radical (opposite in Clematis, stem leaves opposite or whorled in Anemone), usually divided, dissected, or compound, without stipules, but with the dilated bases of the footstalks half clasping. Flowers polypetalous or apetalous, with the several sets of organs, and the organs of each set entirely distinct and separate. Sepals 3 to 15, often colored like petals and often caducous. Petals 3 to 15, or wanting. Stamens many; rarely few. Pistils many, few, or sometimes solitary, becoming in fruit akenes, follicles, or berries.

Artificial Key to the Genera of the Ranunculaceæ

N.B.— For the genera marked with the asterisk, see fuller floras of Gray, Wood, Britton, etc.

1. Plants with regular flowers. (2)
1. Plants with irregular flowers. (11)
 2. With petals. (9)
 2. Without petals. (8)
 3. Fruit akeniate. (4)
 3. Fruit follicular. (8)
 3. Fruit berry-like **HYDRASTIS** XVII
 4. Sepals valvate in bud. Akenes tailed **CLEMATIS** I
 4. Sepals imbricate in bud. (5)
 5. Peduncles 1-flowered, involucrate. (6)
 5. Peduncles many-flowered, not involucrate. (7)
 6. Involucre remote. Akenes not ribbed **ANEMONE** II
 6. Involucre remote. Akenes ribbed. Flowers umbelled **ANEMONELLA** III
 6. Involucre close, resembling a calyx **HEPATICA** IV
 7. Leaves compound **THALICTRUM** V
 7. Leaves simple **TRAUTVETTERIA** *
 8. Sepals white **ISOPYRUM** VII
 8. Sepals yellow **CALTEA** VIII
 9. Fruit akeniate, in a head. Petals 5, yellow or white **RANUNCULUS** VI
 9. Fruit akeniate, in a head. Petals 5 to 16, scarlet or crimson, or, in exotics, yellow **ADONIS** *
 9. Fruit akeniate, in a slender spike. Plants minute **MYOSURUS** *
 9. Fruit follicular. (10)
 9. Fruit berry-like **ACTÆA** XVI

10. Petals 5, spurred	AQUILEGIA	XII
10. Petals 5, 8-cleft or -lobed	NIGELLA	XI
10. Petals with transformed stamens, numerous, large, and showy	PÆONIA	XVIII
10. Petals small, tubular, 2-lipped	HELLEBORUS	X
10. Petals small, linear, tubular at base	TROLLIUS	*
10. Petals small, 2-lobed. Flowers in compound, drooping racemes	XANTHORRHIZA	*
10. Petals small, hollowed at the tip. Leaves radical and trifoliate	COPTIS	IX
10. Petals very small and stamen-like. Flowers in long racemes	CIMICIFUGA	XV
11. Upper sepal hooded	ACONITUM	XIV
11. Upper sepal spurred	DELPHINIUM	XIII

I. CLÉMATIS, L. VIRGIN'S BOWER. Perennial herbs, or somewhat woody vines climbing by the leafstalks, with opposite leaves, without obvious petals, usually 4 colored sepals, valvate in bud with the edges turned inward. Stamens many. Pistils many. Akenes with the persistent styles much prolonged into hairy or feathery tails.

1. **C. Virginiana, L. COMMON OR VIRGINIA VIRGIN'S BOWER.** A hardy vine, 10° to 15° long, climbing over hedges and thickets and along streams, common from Canada to Ga. and the Miss. Stem smooth, leaves opposite, long-stalked, ternate, with ovate, acute leaflets, 2' to 3' long, lobed or toothed, sometimes slightly heart-shaped at the base. Flowers rather small, white or whitish, polygamous or diœcious, in leafy, cymose, or paniced clusters, and the persistent styles long and feathery July, Aug.

2. **C. verticillaris, DC. PURPLE VIRGIN'S BOWER.** A woody-stemmed, trailing or climbing vine, of rocky highland or mountain woods from Me. to mts. of N.C. and west and north to Minn., attaining a length of 15° or more. Leaves trifoliate, with ovate, entire or slightly notched or lobed leaflets 1' to 2' long. Flowers large, solitary, bluish-purple, with widely spreading sepals, on long peduncles, and the filaments of the outer stamens dilated and petal-like. May, June.

3. **C. Viórna, L. LEATHER FLOWER.** A climbing vine, 10° to 15° long, of rich soils from southern Pa. to Mo. and southward. Leaves mostly pinnate, of 3 to 7 ovate or oblong leaflets, the uppermost and lowest leaves being often simple. Flowers large, solitary, nodding, ovoid, or bell-shaped, purple, purplish, or red, *remarkable for their very thick and leathery sepals, which are ovate and nearly closed, or with their tips only recurved.* May to Aug.

4. **C. crispa, L. MARSH CLEMATIS. BLUE JESSAMINE.** A climbing vine of marshes and river banks from southern Va. to Fla. and Tex., resembling the last in having large, solitary flowers, but differing mainly in having the leaflets of the pinnate leaves mostly trifoliate and the more bluish-purple flowers *somewhat cylindrical below and the sepals above spreading with thin, broad, and wavy margins.* Regarded by some as the most beautiful of our native species. May, June.

II. ANEMONE, L. ANEMONE. Erect, perennial herbs with lobed, divided, or dissected, radical leaves, and 2 or 3 others, opposite or whorled on the stem, forming an involucre usually

remote from the flower or flowers. Sepals few or many, imbricated in the bud, colored and deciduous. Petals none. Stamens indefinite. Pistils usually many, becoming akenes, massed in roundish or oblong heads.

§ *Pulsatilla*. Akenes with long, feathery styles No. 1

§ *Anemone proper*. Styles not feathery. (°)

* Akenes woolly Nos. 2, 3, 4

* Akenes merely downy or nearly smooth Nos. 5, 6

* Exotics. Cultivated No. 7

1. *A. Nuttalliana*, DC. WILD PASQUE FLOWER. AMERICAN OR NUTTALL'S PASQUE FLOWER. A plant 3' to 12' high, of the prairies and dry hills of Ill., Mo. and westward and northward. Stem silky, hairy. Flower single, showy, pale purple, of 5 or 6 ovate sepals, 1' long, and silky outside, blooming before the leaves, which are divided into many narrow, linear, pointed lobes. The involucreal leaves, subulately divided or cleft, are united at the base into a cup. It is specially distinguished from the other species by the long hairy styles of its akenes, which become feathery tails like those of *Clematis*. March, April.

2. *A. Caroliniana*, WALT. A slender, simple-stemmed plant 6' to 10' high, growing in open places from N.C. to Neb. southward to Ga. and Tex. Leaves springing from its tuberous rootstock, once or twice 3-cleft or -parted. The 2 or 3, sessile, involucreal leaves, half way up the stem, similar. Flower single, erect, 9" to 18" across with 6 to 30, oblong, linear, whitish, or rose-colored sepals, the outer and wider ones purple-dotted. Head of densely woolly akenes, oval-oblong. April, May.

3. *A. Virginiana*, L. TALL ANEMONE. THIMBLEWEED. A tall, stout plant common in woods, meadows, and hilly pastures from Canada to S.C. west to Kan. and Manitoba. Radical leaves on petioles 6' to 10' long, 3-parted, with variously toothed and lobed, ovate-lanceolate divisions. Scape erect, hairy, 2° to 3° high, branching at the involucre, which consists of 3 long-stalked, 3-parted, cut-lobed leaves. Main flower-stalk naked; the lateral ones with their own secondary, 2-leaved involucres, from the axils of which branching may again occur. Each peduncle bears a single flower an inch or more across, with about 5 greenish-white, acute or obtuse sepals succeeded by an oblong head of woolly fruit 9" in length. June, July.

4. *A. cylindrica*, GRAY. LONG-FRUITED ANEMONE. More slender than No. 3 and not so tall. Found in dry woods and open places from N.H. to northern N.J. and west to Kan. The radical leaves with petioles 3' to 6' long are 2' to 3' wide and 3-parted, with wedge-shaped, gashed, and toothed segments. Stem silky-pubescent, 1° to 2° high, with the 3-divided, petioled, involucreal leaves twice or thrice as many as the 2 to 6, very long, erect, umbellate, generally naked peduncles. Each of these bears a single flower 9" across, with about 5, greenish-white, obtuse sepals, succeeded by a cylindrical head 1' long, of woolly akenes. May.

5. *A. Pennsylvanica*, L. Rather stout and hairy, 12' to 20' high, of low and wet grounds, from western New Eng. to Pa. west to Kan. and Wis. Radical leaves long-stalked, large-veined, about 5-parted, with wedge-shaped, 3-lobed, pointed segments. From the base of the 3, similar but sessile, involucreal leaves spring several long peduncles, the main one naked, but the side ones with secondary, 2-leaved involucres. Each peduncle bears a single, large, white flower 12" to 18" across, with about 5 obovate or obtuse sepals succeeded by a globose head of flat, roundish, smooth, or nearly smooth akenes. June to Aug.

6. *A. nemorosa*, L. WIND-FLOWER. WOOD ANEMONE. Small, simple-stemmed, nearly smooth, 6' to 9' high, of low woods from Me. to Ga. and

west to the Rockies. Springing from a slender rootstock, it bears at the top a single, white flower 1' across, purplish on the outside with 4 to 10 obovate sepals, succeeded by a globose head of 15 to 20 nearly smooth, beaked akenes. 1' to 2' below the flower is the involucre of 3 long-stalked, ternate leaves. The wedge-shaped, oblong, toothed leaflets of these have sometimes the lateral ones 2-parted, making the leaves quinate and giving the name *quinquefolia* to the species, which is regarded by some as distinct from the Old World *A. nemorosa*. A similar radical leaf grows from a sterile rootstock. April, May.

7. *A. japonica*, SIEB. AND ZUCC. A hardy, autumn-blooming exotic from Japan. It is 2° to 3° high, with variously cut and toothed, ternate leaves and many white or rose-colored flowers 2' to 3' across.

III. ANEMONÉLLA, SPACH. A smooth, perennial herb, 4' to 10' high, with a root of clustered, oblong tubers, compound, radical leaves, and a slender stem bearing a compound involucre with an umbel of apetalous flowers. It resembles *Anemone* in flowers and habit and *Thalictrum* in leaves and fruit. A monotypic genus of United States and Canada.

1. *A. thalictroides*, SPACH. RUE ANEMONE. Common from Me. to Ga. and from the Atlantic to the Miss. The common petiole of the 2 to 3-ternately compound, radical leaves, is 2' to 4' long, with the oval, subcordate leaflets 3-lobed at the end, resembling those of the meadow rue. The 2 to 3-leaved, ternate or simple, involucre leaves similar. The 5 to 10 oval, white, or rarely pinkish sepals 6" long, remaining a long time. Stamens numerous. Akenes 5 to 12, sessile, ovoid, *strongly ribbed*. April, May.

IV. HEPÁTICA, DILL. LIVERLEAF. HEPATICA. Low, perennial herbs with fibrous roots and long-stalked, radical leaves, specially characterized by the calyx-like involucre of their many, one-flowered, hairy scapes. The 3-lobed, cordate, leathery leaves come up after the flowers and remain till their successors appear the following spring. The involucre of 3 sessile, entire, ovate, leaf-like bracts is very close to the flower. The latter consists of 5 to 12 blue, purplish, or nearly white sepals, numerous stamens, and 6 to 12 pistils, becoming in fruit oblong, pointed, hairy akenes.

1. *H. triflora*, CHAIX. A familiar harbinger of spring, common in woods from Me. to Ga. and from the Atlantic to the Miss. It has the lobes of the leaves and the bracts of the involucre obtuse. April.

2. *H. acutiflora*, DC. The same as No. 1, except that the lobes and bracts are acute. Though treated as distinct species by most botanists, these two are in all probability merely varieties. April.

V. THALÍCTRUM, TOURN. MEADOW RUE. Perennial herbs with ternately compounded, radical and cauline leaves, the latter alternate, with leafstalks dilated at the base, and all with the leaflets and other divisions stalked. Flowers apeta-

lous, with 4 to 5 roundish, concave, petaloid or greenish, usually caducous sepals. Stamens indefinite, flattened, exserted. Akenes few, ribbed, grooved or winged, sessile or stipitate.

1. *T. dioicum*, L. **EARLY MEADOW RUE.** A slender, smooth plant, 1° to 2° high, of rocky woods and hills from Me. to Ga. and Ala. west to Mo., with the leaves all ternately decomposed, on general petioles, those of the stem 1' to 3' long, shortening upward, with roundish, drooping, 3 to 7-lobed leaflets, about 9" wide. Flowers purplish, or pale green, diœcious, in a terminal panicle, their yellowish anthers drooping on thread-like filaments and the ovoid, strongly ribbed akenes sessile or barely stipitate. April, May.

2. *T. polygamum*, MUHL. **TALL MEADOW RUE.** Tall, smooth, or pubescent, with a jointed, furrowed, hollow stem, 4° to 10° high, common in wet meadows from New Eng. to Ohio and southward. Stem leaves sessile (without a common petiole); leaflets roundish or obovate, with 3 pointed lobes. Flowers polygamous, white, in large and diffuse panicles, with the white filaments of the stamens much dilated upward, and the ribbed, ovoid akenes distinctly pointed. July, Aug.

3. *T. purpurascens*, L. **PURPLISH MEADOW RUE.** Very like the preceding, with about the same range, but not so tall, its purplish stem, 3° to 5° high, blooming a month earlier and usually found in dry uplands and hills. Stem leaves sessile; the lowest short-stalked. Flowers diœcious, greenish or purplish. Akenes ovoid, smooth or downy, short-stiped and winged. May, June.

4. *T. clavatum*, DC. **MOUNTAIN MEADOW RUE.** Found in the mts. of Va., W. Va., and southward, resembling No. 1 in size and appearance, but with the white flowers all perfect and in corymbs with strongly club-shaped or spatulate filaments under short anthers, and 5 to 10 flat, obliquely ovoid or crescent-shaped akenes tapering to a minute stigma at one end, a slender stipe at the other. The biternate stem leaves are petioled, and all have the leaflets roundish, with 3 to 5 lobes. June, July.

5. *T. débile*, BUCKLEY. Occurring in early spring in rocky, mountain woods of Ga. and Ala., resembling No. 1, but with *prostrate stem*, 6' to 12' long, from clustered tubers.

VI. RANÚNCULUS, L. CROWFOOT. BUTTERCUP. Annual or perennial herbs, with alternate, simple, mostly lobed or divided leaves, and mostly yellow, solitary, or corymbed flowers. Sepals 5, ovate. Petals 5, roundish, shining, with a nectariferous scale or pit at the base inside. Stamens indefinite. Akenes many, mostly flattened, tipped with a point or a lengthened style, and collected in an oblong or roundish head.

Leaves finely dissected, under water	Nos. 1, 2
Flowers very small, less than 6" across	Nos. 3, 4, 9
Flowers large, 1' or more across,	
With spreading sepals	Nos. 5, 6, 7
With reflexed sepals	Nos. 8, 10

1. *R. aquatilis*, L., Var. *trichophyllus*, GRAY. **WHITE WATER CROWFOOT.** Perennial, aquatic; *entirely under water except the flowers*; common in ponds and sluggish streams from New Eng. to S.C. west to the Rockies. Stem 1° to 2° long, smooth, round, slender, weak, and branching. *Leaves flaccid*, 6" to 12" across in their roundish outline, *dissected*

into many, forked, hair-like segments, and collapsing when taken from the water. Flowers about 1' in diameter. Petals white except the yellow claws. Akenes transversely wrinkled, in a globose head. June to Aug.

2. *R. multifidus*, PURSH. YELLOW WATER CROWFOOT. A floating herb of ponds and stagnant waters, from New Eng. to southern Pa., Mo., and northward, becoming perennial sometimes by rooting from the nodes. Similar to No. 1, but differing in its larger and coarser leaves, the upper ones often rising out of the water and being 3 to 5-parted, with variously divided lobes, and in its larger flowers 9" to 18" across, with 5 to 8 bright, deep yellow petals twice the length of the reflexed sepals. The beaked akenes in a globose head. May to July.

3. *R. pusillus*, POIR. LOW SPEARWORT. TINY CROWFOOT. An annual of wet places near the coast, from southern N.Y. to Fla. west to La. and Tex. Stem erect or ascending, weak, slender, loosely branching, 6' to 15' high. Leaves entire, or with minute, remote teeth, the lowest round, ovate, or cordate, 6" long, on long petioles; the upper much narrower 12" to 18" long. Flowers very small, 2" to 3" wide, with 2 to 5 yellowish petals, 3 to 10 stamens, and a few beakless akenes in a globose head. April to July.

4. *R. abortivus*, L. SMALL-FLOWERED CROWFOOT. KIDNEY-LEAVED CROWFOOT. Common in woods and along brooks from the Great Lakes to the Gulf of Mexico, especially noticeable for its small (abortive) petals and for the difference between its radical leaves, which are round, heart-shaped, crenate, and petiolate, and those of the stem, which are nearly or entirely sessile and 3 to 5-parted or -divided. Radical leaves 12" to 18" in diameter. Stems smooth, branching, 6' to 2° high. Flowers 2" to 3" across, with the reflexed sepals longer than the pale yellow petals. Akenes with a minute, curved beak, collected in a globose head. April to June.

5. *R. fasciculâris*, MUHL. EARLY CROWFOOT. Low, erect, or ascending, 6' to 12' high, in rocky woods or hills, from New Eng. to N.C. and westward. Stem silky, pubescent, from a cluster of thickened, fleshy, fibrous roots. Radical leaves, apparently pinnate, petioled, ternate, with the lateral divisions sessile and the terminal division long-stalked and itself again variously divided and cleft. Flowers bright yellow, 1' across, with 6 or 7 obovate petals twice as long as the spreading sepals, and with a broad scale. Akenes scarcely margined, and with a slender beak in a globose head. April, May.

6. *R. septentrionalis*, POIR. CREEPING CROWFOOT. Very variable. Found in low and wet grounds from Canada to Ga. and Ky. Stem smooth or sometimes hairy, 1° to 3° high, ascending or erect in spring, later sending from the base prostrate branches 1° to 4° long. Leaves large, petioled, ternate, with stalked, broadly wedge-shaped or ovate divisions, which are unequally 3-cleft and variously cut or toothed. Flowers, bright yellow, 1' across. Petals obovate, much longer than the spreading sepals. Head of flat, strongly margined, stoutly beaked akenes, globose or oval. This form is very like and much confounded with *R. repens*, native westward, but supposed to be introduced from Europe in the eastern U.S. May to Aug.

7. *R. âcris*, L. TALL CROWFOOT OR LATER BUTTERCUP. Tall, naturalized from Europe, common in meadows and pastures, perhaps the most common in the eastern and northern U.S. Stem round, hollow, usually hairy, erect, 2° to 3° high, branching, many-flowered. Lower and tufted, radical leaves petioled, 3-divided, with the sessile 3-cleft or -parted divisions again cut or lobed; upper leaves widely separated, merely 3-parted, and nearly sessile. Flowers 1' in diameter, on terete peduncles; petals golden-yellow, much longer than the spreading sepals. Akenes short-beaked, in a globose head. Cattle avoid this species on account of

its acrid juices, a property, however, which disappears in drying, when it is cut with hay. A double-flowered variety is cultivated in gardens. June to Sept.

8. *R. pennsylvanicus*, L. BRISTLY CROWFOOT. Very bristly, hairy. *Stem erect, stout, leafy*; 1° to 2° high, common in wet, open places from Canada to Ga. and west to the Rockies. Leaves all 3-divided, with the stalked divisions again 3-cleft, with lanceolate, toothed lobes. *Flowers bright yellow, many, small, 3'' to 4'' across; sepals reflexed.* Akenes smooth, sharp-beaked, in a dense, oblong, or cylindrical head. June to Aug.

9. *R. recurvatus*, POIR. HOOKED CROWFOOT. Pale green, erect, usually hairy, common in damp woods, from Canada to Fla. and Mo. Leaves all nearly alike, long-stalked, 2' to 3' wide, 3-parted, with the oval segments lobed and toothed. *Flowers small, less than 6'' across, with inconspicuous, pale yellow petals, shorter than the reflexed sepals.* Akenes with a long-hooked beak, in an ovate or roundish head. May to June.

10. *R. bulbosus*, L. BULBOUS CROWFOOT OR EARLY BUTTERCUP. Hairy. Stem erect, furrowed, hollow, about 1° high from a bulb-like root. Naturalized from Europe and common in fields and by roadsides, but only so in New Eng. and here and there elsewhere in the eastern U.S. Radical leaves ternate with sessile lateral divisions, and the terminal one 1-stalked and 3-parted. Peduncles grooved. *Flowers more than 1' across, with 6 or 7 glossy, deep yellow petals much longer than the reflexed sepals.* The short-beaked akenes in a roundish head. May to July.

VII. ISOPYRUM, L. Smooth, slender perennials. Sepals 5 to 7, deciduous, petaloid. Petals 5, small, tubular, or none. Stamens many. Pistils few, becoming follicles in fruit. Leaves 2 to 3, ternate. Flowers white, axillary and terminal.

1. *I. biternatum*, TORR. AND GRAY. FALSE RUE ANEMONE. Small and delicate, resembling Rue Anemone, found in moist, shady places from Ohio to Minn. southward to Fla. and Tex. Stem 6' to 12' high, branching above, from fibrous, sometimes tuber-bearing roots. Radical leaves, long-petioled and biternate; those of the stem, at least the upper ones, simply ternate; leaflets obovate and 2 to 3-lobed. Flowers white, 6'' to 9'' broad. Sepals 5. Petals none. Stamens many with white, club-shaped filaments. Pistils about 4, becoming in fruit sessile, spreading, strongly veined, 2-seeded, beaked follicles. April, May.

VIII. CÁLTHA, L. MARSH MARIGOLD. Fleshy, perennial herbs, with large, simple, heart-shaped or roundish, entire or crenate, mostly radical leaves, growing in wet or marshy ground. Sepals 5 to 9, colored. Petals none. Stamens numerous. Pistils 5 to 10, becoming compressed, spreading, many-seeded follicles in fruit.

1. *C. palustris*, L. Smooth, stout, showy; common in wet grounds from New Eng. to N.C. and westward to Ore. Stem round, furrowed, hollow, dichotomously branching, 1° to 2° high, erect, ascending or sometimes trailing, growing from a large, branching root. Leaves cordate, kidney-shaped or orbicular, 2' to 4' wide, smooth, veiny, and of a deep, glossy green; radical and lower ones on long petioles; the upper ones

sessile. Flowers few, pedunculate, golden-yellow, 12" to 18" across. Young leaves used as a potherb. Erroneously called *Cowstip*. April, May.

IX. CÔPTIS, SALISB. Low, smooth, perennial herbs, with long, slender, creeping rootstocks, compound radical leaves, and white flowers on scapes. Sepals 5 to 7, petaloid, deciduous. Petals 5 to 7, small, thickened, tubular at the end. Stamens numerous. Pistils 5 to 10, becoming in fruit stipitate, beaked, 4 to 6-seeded follicles, spreading in a radiate manner.

1. *C. trifolia*, SALISB. **GOLDTHREAD.** A delicate little plant, 3' to 6' high, with shining, evergreen, long-petioled, trifoliolate leaves, and 1-flowered scapes, found in bogs and mossy woods from New Eng. to Md. in the mts. west to Iowa. Stem subterranean, consisting of long, thread-like, golden-yellow fibers, which are bitter and tonic. Sepals oblong, concave, white. Petals small, just distinguishable by their yellow color among the white stamens. Sometimes called also *Canker Root*. May.

X. HELLÉBORUS, L. HELLEBORE. Coarse, perennial herbs, with palmately or pedately divided leaves, and solitary, nodding flowers. Sepals 5, petal-like, usually greenish, persistent. Petals 8 to 10, very small, tubular, 2-lipped. Stamens numerous. Pistils 3 to 10, becoming in fruit several-seeded pods dehiscing at the top when ripe.

1. *H. viridis*, L. **GREEN HELLEBORE.** A European plant, sometimes cultivated for ornament and sparingly naturalized in the eastern U.S. Stem smooth, 1° to 2° high. Radical leaves, long-petioled, pedately divided into 7 to 10 lanceolate, serrate segments. Stem leaves somewhat similar, but sessile. April, May.

2. *H. niger*, L. **BLACK HELLEBORE. CHRISTMAS ROSE.** Another European species, cultivated in gardens, has solitary, white flowers, 2' to 3' wide, turning pinkish and finally green, on scapes, very early in spring.

XI. NIGÉLLA, L. FENNEL FLOWER. Old World, annual herb, with leaves dissected like those of the fennel, into many linear segments. Several species are cultivated in American gardens for ornament or use. Sepals 3, and colored. Petals 5, 3-cleft. Pistils represented by 5 styles, which are usually united below into a 5-celled pod, containing large, blackish, spicy seeds.

1. *N. Damascēna*, L. **COMMON FENNEL FLOWER. LOVE-IN-A-MIST.** A hardy ornament of country gardens, with its white or pale blue, solitary flowers encircled and covered by an involucre of leaves finely dissected like those of the stem. Among many common names are *Ragged Lady*, *Lady in Green*, etc. June to Sept.

2. *N. sativa*, L. NUTMEG FLOWER. A smaller species from Egypt, without the involucre and with the capsules distinct. June to Sept.

XII. AQUILÉGIA, L. COLUMBINE. Perennial herbs, with erect, branching stems, ternately compounded leaves, and large and showy flowers terminating the branches. Sepals 5, regular, colored, spreading. Petals 5, all similar, with a dilated mouth, attached by one margin to the receptacle and prolonged backward into a hollow spur. Stamens numerous, the inner ones larger and sterile. Pistils 5, becoming erect, many-seeded follicles with the slender, persistent styles.

1. *A. Canadensis*, L. WILD COLUMBINE. A slender, usually smooth plant, common in rocky woods throughout the eastern, southern, and central U.S. Radical leaves biternate; leaflets obtusely lobed. The flowers, 2' long, scarlet without, orange or yellow within, and further adorned by their long, exserted, golden stamens and styles, are pendulous on gracefully bending peduncles, until in fruit the follicles become erect. April to June.

2. *A. brevistyla*, Hook. SMALL-FLOWERED COLUMBINE. An erect, slender, branching plant, 6' to 18' high, of S. Dak. and northward. Leaves somewhat similar to those of No. 1. Flowers nodding, but only 8" long, blue or purple, with short, incurved spurs. Stamens and styles scarcely exserted. June, July.

3. *A. vulgaris*, L. COMMON COLUMBINE. A stout, erect plant from Europe, common in gardens and escaped from cultivation in many places. It is specially distinguished from our native species by its *hooked spurs*. It is admired for its smooth, handsome, and abundant foliage and its numerous flowers, which vary from blue and purple to white, and are often double. It lacks the grace and delicacy of No. 1. May to July.

XIII. DELPHÍNIUM, L. LARKSPUR. Erect, annual or perennial herbs, with alternate, palmately divided or cut leaves, and showy, irregular flowers in terminal racemes. Sepals 5, petal-like, irregular, the upper one produced backward into a hollow spur. Petals 4, irregular, distinct, the upper pair with spurs extending into that of the calyx, or rarely 2 united. Pistils 1 to 5, becoming many-seeded follicles in fruit.

1. *D. Consólida*, L. FIELD LARKSPUR. KNIGHT'S SPUR. A smooth, European annual, common in gardens and sparingly naturalized in fields and by roadsides, 12' to 30' high, with spreading branches, sessile or short-stalked leaves cleft into many linear divisions, a loose terminal raceme, 6' to 10' long, of white or blue pediceled flowers, *the petals 2 united into 1*, whence the specific name, *Consólida*, and a *single erect, smooth follicle* in fruit. Cultivation has produced many varieties. June to Aug.

2. *D. Ajácis*, L. ROCKET OR AJAX LARKSPUR. A European annual, cultivated in gardens, resembling No. 1 in its dissected leaves, united petals, and single follicle, but with its more numerous flowers crowded in a long, spicate raceme, a downy pod, and a shorter spur.

3. *D. azureum*, Mx. AZURE OR CAROLINA LARKSPUR. A perennial, with a slender, downy, mostly simple stem, 1° to 2° high, of prairies and open grounds from Ill. to Fla. and westward. Leaves 3 to 5-parted, with

many-cleft divisions. Flowers few, pediceled, in an erect, straight raceme, blue varying to white, with spur curved upward, and the 3 follicles erect. Species very variable. May, June.

4. *D. exaltatum*, AIT. TALL LARKSPUR. A tall and slender perennial, of rich soils from Pa. to Minn. southward to the mts. of N.C. and Ala. Stem 2° to 5° high, downy above, smooth or nearly so below. Leaves large, all but the upper ones petioled, 3 to 5-cleft, with narrow, diverging, lanceolate divisions. Flowers many, in long, dense racemes, bright purplish-blue, and downy. Follicles 3, erect, with an awl-shaped beak. June to Aug.

5. *D. tricorne*, Mx. DWARF LARKSPUR. A stout perennial, 1° to 3° high, of open woods and uplands from western Pa. to the mts. of Ga. west to Ark. and Minn. Stem, simple, smooth or slightly downy. Leaves with slender petioles, 5-parted, the divisions 3 to 5-cleft, with linear or obovate lobes. Flowers light blue or white, generally few, in a loose raceme. Pods 3, widely spreading. April, May.

XIV. ACONITUM, L. MONKSHOOD. WOLFSBANE. Tall and erect or long, ascending, or trailing perennials, with tuberous or turnip-shaped, poisonous root, palmately divided leaves, and large, showy, irregular flowers. Sepals 5, colored, very irregular; the upper one hood or helmet-shaped, hence called the helmet or hood, much the largest. Petals 2 or 5, the two upper spur-like bodies raised on claws and covered by the hood; the 3 lower ones entirely suppressed or very minute. Stamens numerous. Pistils 3 to 5, becoming many-seeded follicles.

1. *A. uncinatum*, L. WILD MONKSHOOD. In woods and along streams from southern Pa. southward in the mountains to Ga. Also in Wis. Stem slender, erect but weak, flexuous, tending to climb, 2° to 4° long. Leaves leathery, dark green, 4' to 5' across, palmately, 3 to 5-parted, with coarsely toothed, ovate-lanceolate lobes. Flowers blue or purple, large, 3 or 4, in a loose terminal panicle. Helmet obtusely conical, erect, acute in front, slightly beaked. July, Aug.

2. *A. reclinatum*, GRAY. TRAILING WOLFSBANE. In the Alleghanies of Va. and southward to Ga. Stem smooth, trailing, 3° to 8° long. Leaves deeply 3 to 7-cleft, with wedge-shaped, incised, or 2 to 3-lobed divisions, thin and petioled except the upper ones. Flowers white, in very loose panicles. Helmet elongated, conical, soon horizontal, with a straight beak in front. July, Aug.

3. *A. Napellus*, L. MONKSHOOD. ACONITE. From Europe. Cultivated in gardens. Stem straight, 3° to 4° high, from a turnip-shaped root. Leaves deeply cleft, and cut into linear segments. Flowers many, in a dense, spicate, terminal raceme, dark blue. Helmet broad and low, resembling a monk's cowl or hood. White and rose-colored varieties occur. July, Aug.

XV. CIMICÍFUGA, L. BUGBANE. Perennial herbs, with large, ternately decompound leaves, and long, wand-like racemes of white flowers. Sepals 2 to 5, petaloid, caducous. Petals 1 to 8, small, resembling stamens, with claws, 2-horned at the apex. Stamens very numerous, with white filaments. Pistils 1 to 8, becoming dry, dehiscent pods.

1. C. racemosa, **NUTT.** **BLACK SNAKEROOT. BLACK COHOSH.** Common in upland woods from Canada to Ga. Stem slender, 3° to 8° high, from a thick rootstock, with very long, clustered racemes, becoming 1° to 3° long in fruit. Leaves ternately and pinnately compound, the leaflets incisely serrate. Pistil 1, sometimes 2 or 3, sessile, becoming a follicle with smooth, flattened seeds, arranged horizontally in two rows as in *Actæa*. The plant resembles a tall *Actæa*. June, July.

XVI. ACTÆA, L. BANEERRY. Perennial herbs, with large, ternately compounded leaves and a short, terminal raceme of white flowers. Sepals 4 or 5, caducous. Petals 4 to 10, small, long-clawed, spatulate. Stamens very many, with slender, white filaments. Pistil 1, with a 2-lobed, sessile, depressed stigma. Fruit a round berry with many smooth, flattened seeds.

1. A. spicata, **L., Var. rubra**, **AIT.** **RED BANEERRY. RED COHOSH.** Erect, 1° to 2° high, common in rich woods, especially in the northern U.S. Raceme hemispherical or ovate. Petals acute. Pedicels slender. Berries cherry-red, sometimes white. May.

2. A. alba, **BIGEL.** **WHITE BANEERRY. WHITE COHOSH.** Common in rocky woods from Canada to Ga. Like the preceding, except in the pedicels, which are thickened in fruit and red, and the berries white. May.

XVII. HYDRÁSTIS, L. ORANGE ROOT. GOLDEN SEAL. A low, perennial herb, with a single, radical leaf and a 2-leaved, 1-flowered stem springing from a thick, knotty, yellow rootstock, with long, fibrous roots. Sepals 3, petal-like, caducous. Petals none. Stamens many. Pistils 12 to 20, 2-ovuled, ripening into a head of 1 to 2-seeded, crimson berries.

1. H. Canadensis, **L.** In rich woods and meadows from N.Y. to Minn. south to Mo., Ky., and the mts. of Ga. The only species, except one in Japan. Stem 6' to 12' high, with its alternate leaves near the top, the smaller one just beneath the flower, both similar in shape to the larger, long-petioled, 5 to 9-lobed, radical leaf 6' or 8' wide. Sepals greenish-white. Fruit resembling a raspberry. Known also as *Yellow Root*, *Yellow Puccoon*, *Turmeric Root*, *Yellow Indian Paint*.

XVIII. PÆONIA, L. PEONY. Ornamental, Old World perennials, with biternate or bipinnate leaves, and large, showy, terminal flowers. Sepals 5, leaf-like, persistent. Petals 5. Stamens many, becoming mostly petals by cultivation. Pistils 2 to 5, on or surrounded by a fleshy disk and becoming many-seeded, leathery pods.

1. P. officinalis, **L. COMMON PEONY.** Stem annual, herbaceous, smooth, with large, rather irregularly divided leaves, the leaflets ovate or lanceolate. Pods 2, downy. Flowers red, white, flesh-colored, etc., very large and with very many petals. May, June.

ORDER 2. MAGNOLIACEÆ—MAGNOLIA FAMILY

Trees or shrubs, with aromatic, bitter bark, leaf buds inclosed in caducous, membranous stipules, alternate, entire or lobed leaves, and large, regular, showy, and solitary flowers. Calyx and corolla similarly colored, in 3 or more sets of 3, hypogynous and deciduous. Stamens many and hypogynous. Pistils, or 1 to 2-ovuled ovaries, many, closely covering the elongated receptacle and forming in fruit a sort of fleshy or dry cone-like or cylindrical head.

I. MAGNOLIA, L. Trees or shrubs. Leaves large, usually entire, conduplicate in bud, covering and covered by the inclosing stipules. Flowers often fragrant. Sepals 3. Petals 6 to 9. Anthers adnate, introrse, longer than the filaments. Ovaries 1 to 2-seeded, opening at the back when ripe, and the 1 to 2 berry-like seeds hanging from them by a long, slender, elastic seed stalk.

* Native.	Leaves thick, leathery, usually evergreen	Nos. 1, 2
	Leaves thin, scattered along the branches	Nos. 3, 4, 5
	Leaves thin, clustered at the ends of the branches	Nos. 6, 7
* Exotic.	. . . . .	Nos. 8, 9, 10

1. M. grandiflora, L. MAGNOLIA. BIG LAUREL. A large and stately evergreen tree, of swampy woods from N.C. to Fla. and Miss. Trunk 70° to 90° high, 2° to 3° in diameter at the base. Bark gray, nearly smooth. Leaves oblong or obovate, 6' to 12' long, entire, dark, glossy green above, rusty-pubescent beneath. Flowers pure white, very fragrant, 6' to 9' across. Fruit oval, 3' to 4' long. May.

2. M. glauca, L. SMALL OR LAUREL MAGNOLIA. SWEET BAY. WHITE BAY. A shrub or small tree, 5° to 20° high, of marshy grounds from Mass. to Fla. thence to Tex. Leaves 3' to 6' long, broad, oval, or oblong, acute at base, rather obtuse at apex, leathery, evergreen in the South, dark green above, glaucous beneath. Flowers very fragrant, 2' to 3' across, depressed-globose, with white, obovate, rounded petals. May to July.

3. M. acuminata, L. CUCUMBER TREE. A large tree, of upland forests from southern N.Y. to Ill. and southward. Trunk remarkably straight and cylindrical. Leaves 5' to 10' long, thin, green on both sides, oblong, acuminate, acute at base. Flowers oblong-bell-shaped, greenish-white, 2' high. Fruit 2' to 3' long, resembling when young a small cucumber. May.

4. M. macrophylla, Mx. LARGE-LEAVED MAGNOLIA. A small tree, of woods and river banks from southeastern Ky. to Fla. and La. Leaves and flowers very large; the former, 1° to 3° long, obovate-oblong, cordate, smooth, and green above and glaucous-white beneath; the latter, open bell-shaped, 8' to 15' across, white, with a purple base. Fruit bright pink, 4' to 6' long, ovoid-cylindric. June.

5. *M. cordata*, Mx. YELLOW CUCUMBER TREE. A small tree, of the uplands of Ga. and S.C., with a deeply furrowed bark. Leaves ovate or oval, 4' to 6' long, long-petioled, acute, *slightly cordate*, whitish and downy beneath. Flowers about 4' wide, with 6 to 9 oblong, lemon-yellow petals. Fruit cylindrical, 3' long. May.

6. *M. Umbrella*, LAM. UMBRELLA TREE. A small tree, common in the Southern States and extending into Pa. Leaves obovate-lanceolate, 16' to 20' long, silky when young, soon smooth, clustered, as if whorled, umbrella-like, at the ends of the branches. Flowers white, terminal, 4' to 7' across, slightly scented. Fruit conical, rose-red, 4' to 5' long. May, June.

7. *M. Fraseri*, WALT. EAR-LEAVED UMBRELLA TREE. A small, slender tree, from Va. southward. Leaves 6' to 15' long, clustered at the ends of the branches as in No. 6, but *obovate-oblong, with a narrow, auriculate base*. Flowers white, 3' to 8' across, with obovate-spatulate petals, 4' long, narrowed into claws. Fruit rose-colored, 3' to 4' long. April, May.

8. *M. obovata*, THUNB. PURPLE MAGNOLIA. A hardy Japanese shrub, 5' or 6' high, with strongly veined, smooth, dark green, *obovate*, acute, deciduous leaves tapering to a leafstalk. Flowers erect, bell-shaped, pink-purple without and white within. May.

9. *M. conspicua*, SALISB. (*M. YULAN*, DESF.) YULAN OR CHINESE WHITE MAGNOLIA. A small tree from China, half-hardy in the northern U.S., of spreading habit, with obovate, abruptly acuminate, deciduous leaves, 4' to 7' long, and very fragrant, erect, bell-shaped, white flowers, about 6' across, appearing before the leaves. May.

10. *M. Kôbus*, DC. (*M. THURBERI*, HORT.) THURBER'S JAPAN MAGNOLIA. A small tree from Japan, with slender branches, erect habit, narrow, cone-like head, broadly obovate leaves, 3' to 6' long, tapering below, and cream-white flowers, 4' to 5' across. April, May.

II. *LIRIODENDRON*, L. One or possibly two trees of U.S. and China. Sepals 3, reflexed, soon falling. Petals 6, forming an erect, tulip-shaped, greenish-yellow flower spotted with orange inside, 2' to 3' across. Stamens with long, slender filaments and long, adnate, extrorse anthers. Pistils long, narrow, flat, and scale-like, imbricated in a cone, and becoming dry, 1 to 2-seeded, indehiscent samaras falling away when ripe.

1. *L. Tulipifera*, L. TULIP TREE. WHITEWOOD. POPLAR. A large forest tree, of eastern U.S. from Vt. to Fla. west to Ark. and Mich. Leaves long-petioled, smooth, dark green, 3' to 5' long and wide, sometimes cordate, but specially and uniquely characterized by the *truncate or broadly emarginate apex and 2 side lobes, the latter sometimes again 2-lobed*, the whole suggestive of a saddle or saddle cloth. Attaining a height commonly of 80°, often 100° to 150°, with a diameter near the base of 2° to 3°, sometimes 5° or 6°, this tree was pronounced by Michaux to be "one of the most magnificent vegetables of the temperate zone"; surpassing "the buttonwood," its only peer in size among N.A. deciduous trees, "in the perfect straightness and uniform diameter of its trunk for upwards of 40 feet, the more regular disposition of its branches, and the greater richness of its foliage." Its soft, straight-grained, greenish-white wood is well known in carpentry and cabinet-making, as poplar, a name wholly improper, as the tree is no relation to the true poplars. May, June.

ORDER 3. ANONACEÆ — CUSTARD-APPLE FAMILY

Trees or shrubs, with alternate, entire, exstipulate, pinnately veined leaves, and hypogynous, polyandrous flowers, valvate in æstivation. Sepals 3. Petals 6, in two rows. Stamens with short filaments and adnate, extrorse anthers. Pistils few or many, distinct or cohering, mostly fleshy in fruit. Seeds large, flat, and hard. All tropical, except the genus given below.

I. ASIMINA, ADANS. NORTH AMERICAN PAPAW. Shrubs or small trees, with axillary, solitary flowers. Outer row of petals larger than the inner. Stamens many, in a spherical mass. Pistils several or many, distinct, only a few maturing and becoming oblong, pulpy fruits, with several or many flat seeds.

1. A. triflora, DUNAL. COMMON PAPAW. A small tree, 10° to 20° high, along streams from western N.Y. and Pa. to Ill. and southward. Trunk straight, with a smooth, gray bark and slender, spreading branches, giving out an unpleasant odor when bruised. Leaves 8' to 12' long, obovate-lanceolate, acuminate, tapering to a short petiole. Flowers 1' to 2' across, dark purple, with the outer, orbicular petals much longer than the sepals. Fruit oblong-ovate, about 3' long, with a yellowish, fragrant, edible pulp, inclosing 5 to 8 large, oblong, flat, wrinkled seeds. Fruit ripens in Sept. and Oct. March, April.

ORDER 4. MENISPERMACEÆ — MOONSEED FAMILY

Climbing or twining shrubs, with alternate, exstipulate, palmate, or peltate leaves, and hypogynous, diœcious, or rarely polygamous, clustered flowers. Sepals and petals similar, in 3 or more sets, imbricated in bud. Stamens equal to the petals in number and opposite, or several times as many. Pistils 2 to 6, becoming 1-seeded drupes, with the stone or seed curved into a crescent or ring.

Key to Genera

Seeds crescent-shaped. Petals present. Drupes black . . .	MENISPERMUM	I
Seeds crescent-shaped. Petals present. Drupes red . . .	COCCULUS	II
Seeds cup-shaped. Petals absent. Leaves deeply 5-lobed . . .	CALYCOCARPUM	*

* See some fuller flora (as Wood's, Gray's, or Britton & Brown's) for this genus.

I. MENISPÉRMUM, L. MOONSEED. Flowers diœcious. Sepals 6 to 8. Petals 6 to 8, shorter than the sepals. Stamens in the sterile flowers 12 to 24, as long as the sepals, with 4-celled anthers. Pistils in fertile flowers 2 to 4, usually accompanied by several sterile filaments. Drupes with crescent-shaped and flattened seed. Flowers in axillary panicles.

1. M. Canadense, L. AMERICAN MOONSEED. A shrubby vine, found in woods and along streams from Canada to Ga. and Ark., climbing over bushes and thickets. Stems 6° to 12° long. Leaves roundish, cordate, 3 to 7-angled or -lobed and *peltate*, the long, slender petioles being inserted so near the base that their being peltate is sometimes scarcely noticeable. Flowers small, white or yellowish. Drupes 4" in diameter, black with a bloom, resembling small grapes. June, July.

II. CÔCCULUS, DC. Flowers diœcious or polygamous. Sepals, petals, and stamens, each 6. Anthers 4-celled. Pistils 3 to 6. Drupe and seed as in *Menispermum*. Flowers in axillary clusters.

1. C. Caroliniânus, DC. A slender, trailing, or low-climbing vine, along streams from Va. to southern Ill. and Kan. south to Fla. and Tex. Leaves downy, at length smooth above, broadly ovate, 2' to 4' long, cordate or rounded at base, entire or sinuate-lobed. Flowers very small, greenish. Fruit red, of the size of small peas. June to Aug.

ORDER 5. BERBERIDACEÆ — BARBERRY FAMILY

Herbs or shrubs, with alternate or radical, simple or compound, mostly exstipulate leaves, and clustered or solitary, usually terminal flowers. Flowers perfect, except in *Akebia*, and hypogynous. Sepals 2 to 6, in 1 or 2 rows, sometimes with bractlets. Petals as many or twice as many as the sepals, in 1 or more rows. Stamens opposite the petals, and as many, rarely more. Anthers extrorse, with short filaments and, except in *Podophyllum*, opening by 2 valves, hinged at the top. Pistil 1, except in *Akebia*. Style short or none. Fruit a berry or pod. Seeds several.

Key to Genera

Flowers imperfect. Twining vines with digitate leaves	AKEBIA	V
Flowers perfect		
Shrubs. Flowers and wood yellow	BERBERIS	I
Herbs with ternately compound leaves	CAULOPHYLLUM	II
Herbs with deeply 2-parted leaves	JEFFERSONIA	III
Herbs with peltate and palmately lobed leaves	PODOPHYLLUM	IV

I. BÉRBERIS, L. BARBERRY. Erect, hardy shrubs, with drooping racemes of yellow flowers, yellow inner bark and wood, acid berries and leaves clustered in the axil of a branching thorn. Sepals 6, roundish, colored, with 2 to 6 bractlets. Petals 6, obovate, each with a gland at the base inside. Stamens 6, irritable, springing toward the ovary when touched. Style none. Fruit an oblong berry, 1 to few-seeded.

1. **B. Canadensis, PURSH.** AMERICAN BARBERRY. A shrub, 1° to 6° high, found along the Alleghanies of Va. southward to Ga. and in Mo. Twigs slender, reddish-brown. Leaves with the teeth more divergent and less bristly pointed than in the European Barberry. Racemes also with the flowers smaller and fewer (6 to 8). Petals notched at the apex. Berries oval, scarlet. June.

2. **B. vulgaris, L.** COMMON OR EUROPEAN BARBERRY. An Old World, bushy, ornamental shrub, 3° to 8° high, escaped from cultivation and naturalized in the Eastern and Middle States, especially in eastern New Eng. Leaves on the young shoots scattered, merely sharp, 3-forked spines from whose axils, the next season's obovate or spatulate, bristly-toothed leaves, 1' to 2' long, grow in rosette-like clusters. Racemes drooping, many-flowered. Petals entire. Berries oblong or oval, scarlet. May, June.

3. **B. Thunbergii, DC.** A low, Japanese shrub, with obovate, entire leaves, 8" to 12" long, turning red in autumn. Flowers solitary or in pairs, on slender stalks little longer than the leaves. Sepals and berries red. Petals sometimes reddish. April, May.

II. CAULOPHYLLUM, Mx. A smooth, perennial herb, from a thickened, knotted rootstock, with large, ternately compound leaves, and a short, terminal panicle of small, yellowish-green flowers. Sepals 6, with 3 or 4 bractlets beneath the calyx. Petals 6, short, thick, gland-like, opposite the sepals and much smaller. Stamens 6. Style short. Ovary a thin pod, soon ruptured by its 2 growing ovules and falling away, while the drupe-like seeds ripen naked. A monotypic genus of eastern N.A.

1. **C. thalictroides, Mx.** BLUE COHOSH. PAPPOOSE ROOT. In woods, from New Eng. to S.C. west to Minn., Neb., and Mo., 1° to 2° high. Purplish-glaucous when young. Stem leaf usually but one, triternate and sessile, close to the top of the naked stem, which thus seems its stalk and gives the name to the genus. The other principal leaf is the radical one, which is long-petioled and also triternate. There is sometimes a second stem leaf, sessile and biternate. Leaflets obovate, wedge-shaped, 2 to 3-lobed, 1' to 3' long, resembling those of *Thalictrum*. Ripened seeds blue, glaucous, spherical, 4" in diameter, on thick stalks, 3" long. April, May.

III. JEFFERSONIA, BARTON. TWIN LEAF. RHEUMATISM ROOT. A smooth, perennial, stemless herb, from thick, blackish, matted, fibrous roots, with palmately veined, long-petioled, radical leaves, and slender, 1-flowered scapes. Sepals 4, col-

ored, caducous. Petals 8, oblong, spreading. Stamens 8; anthers linear; filaments slender. Ovary ovoid; stigma nearly sessile, 2-lobed, becoming a pear-shaped, many-seeded pod, circumscissile halfway round near the top, which thus forms a conical lid. Seeds many, with a lacerate, fleshy aril.

1. *J. diphýlla*, PERS. In woods, eastern Pa. and western N.Y. to Wis. southward to Va. and Tenn. Scape 8' to 14' high. Leaves 3' to 6' long, 2' to 4' wide, deeply cordate and *deeply parted lengthwise into 2 obliquely ovate leaflets*. Flowers white, 1' across. April, May.

IV. PODOPHYLLUM, L. Low, perennial herbs, from long, creeping rootstocks, with large, palmately lobed, peltate leaves, and solitary flowers. Sepals 6, caducous. Petals 6 to 9. Stamens in one species twice as many as the petals. Anthers linear, opening lengthwise. Stigma large, sessile, peltate. Fruit a large, fleshy, many-seeded berry.

1. *P. peltatum*, L. **MAY APPLE. WILD MANDRAKE.** Common in low, rich woods of Middle, Western, and Southern States, rare in New Eng. Stems 12' to 18' high. Leaves broadly cordate, about 1° in diameter, 5 to 7-lobed, with the lobes oblong, somewhat wedge-shaped, cleft, and toothed; those from the barren stems centrally peltate. The flowering stems have at the top 2 similar leaves, with the petiole attached near the inner edge instead of the center, and in the crotch a single, nodding, white flower, about 2' wide. Fruit oblong-ovoid, 1' to 2' long, opening in July, yellowish, sweet, somewhat acid, edible. The root, used medicinally, and the leaves are drastic and poisonous. Sometimes called *Wild Lemon* and *Hog Apple*. May.

V. AKÉBIA, DECNE. Woody vines from China and Japan, with long-stalked, digitate leaves of 3 to 5 leaflets, and monoecious, apetalous, purple flowers in drooping, axillary racemes. Sepals 3. Stamens 6 in the male flowers. Pistils in the female flowers 3 to 9, with peltate stigma. Fruit oblong-cylindrical berries with black seeds.

1. *A. quinata*, DECNE. A hardy and graceful climber, 6° to 10° high, blooming in early summer, said to be free from injury by fungi or insects. Flowers sweet-scented. Leaflets 5, oblong, emarginate.

ORDER 6. NYMPHÆACEÆ—WATER-LILY FAMILY

Perennial, aquatic herbs, from prostrate rootstocks, with leaves usually long-petioled, peltate or deeply cordate, floating or rising above the water, and flowers long-stalked, axillary, and solitary. Sepals and petals 3 to 6 or very

numerous, imbricated, and passing into each other. Stamens few, or many, in many rows. Pistils few, several or many, separate, immersed in the receptacle or united in a compound ovary.

Key to Genera

Flowers very small	The WATER SHIELDS {	CABÓMBA *	#
		BRASÉNIA *	#
Flowers very large. Leaves above the water		NELUMBO	1
Flowers large. Leaves floating.			
Sepals 4. Petals many, large. Stamens epigynous		NYMPHÆA	II
Sepals 5 or 6. Petals small. Stamens hypogynous		NUPHAR	III

* For these genera, see some fuller flora.

I. NELUMBO, TOURN. SACRED BEAN. Aquatics, with strong, thick, generally tuber-bearing rootstocks growing at the bottom of ponds and sluggish streams. Flowers large and showy, on peduncles equaling or exceeding the leaves. Sepals and petals many, erect or spreading. Stamens many. Pistils several, distinct, becoming 1-seeded nuts immersed in separate cavities in the flat-topped obconical receptacle.

1. N. lutea, PERS. YELLOW NELUMBO. WATER CHINQUAPIN. In stagnant waters, Conn., northern and southern N.J., and other localities south to Fla. and west to Mich. and La. Leaves centrally peltate, usually circular or nearly so, 10' to 18' in diameter, entire, concave, and raised high above the water. Flowers 4' to 10' across, with obovate, obtuse, concave, pale-yellow petals 3' to 4' long. The nuts, resembling small acorns with the entire kernel embryo, are edible, as are also the tubers borne by the rootstock. June (S.) to Aug. (N.).

2. N. Indica, PERS. INDIAN LOTUS. FALSE LOTUS. SACRED BEAN (of the Orient). Native of India, Persia, eastern Asia, and Australia. Extensively cultivated for ornament. Naturalized near Bordentown, N.J. Leaves, 2° to 3° across, glaucous, thin, concave, high above the water or some floating. Flowers 4' to 10' across, usually pink, higher than the leaves. Peduncles and petioles 3° to 6° long. Popularly known as *Egyptian Lotus*, but erroneously, the true Egyptian Lotus being either of two *Nymphaeas*, *N. caerulea* and *N. Lotus*, the *Blue Lotus* and *White Lotus* respectively, especially the former. July, Aug.

II. NYMPHÆA, TOURN. WATER LILY. Sepals 4. Petals many, attached to the sides of the ovary and passing gradually into the many stamens with broad filaments which are inserted on the top or upper part of the ovary. Pistils many, united into a compound ovary, many-celled and many-seeded, with radiating stigmas. Fruit depressed-spherical, enveloped with the remains of the withered petals and ripening under water. Seeds in an open, sac-like aril.

1. N. odorata, AIT. SWEET-SCENTED OR WHITE WATER LILY. Common in ponds and sluggish waters from Me. to Minn. south to Fla. and La. Leaves floating, orbicular, 4' to 12' in diameter, entire, cleft from the base to the insertion of the petiole at the center, the lobes diverging, touching, or overlapping, dark green above, deep red or reddish-green

beneath. Flowers very fragrant, white with a tinge of pink, 3' to 5' wide. Filaments yellowish. Seeds oblong, stipitate, half as long as the aril. July, Aug.

III. NUPHAR, SMITH. POND LILY. Flowers yellow or sometimes purplish, blooming all summer. Leaves cordate, ovate or oval or oblong-sagittate, floating or emersed. Sepals 5 or 6, thick, colored within, partly green without, roundish, concave. Petals many, small, stamen-like, and with the very many stamens hypogynous. Ovary compound, with a many-rayed, sessile stigma. Fruit ovoid, naked, ripening above the water. Seeds without an aril.

1. N. advena, AIT. f. YELLOW POND LILY. SPATTER DOCK. A stout, coarse, somewhat repulsive aquatic, often called *Frog Lily* in consequence, common in muddy, sluggish waters from Me. to the Rockies south to Fla. and Tex. Leaves floating or emersed, entire, dark green above, pale and slimy beneath when floating, ovate or oval, 6' to 12' long, deeply cordate, the sinus 2' to 4' deep, and the petiole half cylindrical. Flowers erect, on a thick stalk, globular, 18" to 36" in diameter. Sepals 6. Petals thick, truncate, fleshy, shorter than the stamens. Stigma 12 to 20-rayed.

ORDER 7. SARRACENIÆÆ — AMERICAN PITCHER-PLANT FAMILY

Stemless, perennial, bog herbs, with fibrous roots, pitcher or urn-shaped or trumpet-shaped leaves, and large, nodding flowers on scapes. Flowers perfect, hypogynous. Sepals 5. Petals 5. Stamens many. Pistil 1, compound, of a few carpels, with many ovules. Interesting plants, both from their oddity and from their reputation as being insectivorous. The family comprises but 3 genera, *Heliamphora* of Guiana, *Darlingtonia* of Cal. and Ore., each including but one species, and *Sarracenia* of the eastern, mainly Atlantic, U.S., including 6 or 8 species. The ordinary pitcher plants of the conservatories belong to the East Indian Pitcher-plant Family (*Nepenthaceæ*).

I. SARRACENIA, TOURN. Leaves hollow, with a wing on one side and a hood or lid on the other at the open top. Calyx 3 to 4-bracted. Sepals colored, persistent. Petals deciduous, obovate or oblong, incurved or drooping. Ovary 5-celled, with many ovules on central placentæ. Style short, expanding at the top into an umbrella-shaped membrane spreading out over

the ovary and stamens beneath it and covering the hooked stigmas under its 5 projecting points.

Leaves pitcher-shaped	No. 1
Leaves trumpet-shaped. Hood erect.	No. 2
Leaves trumpet-shaped. Hood arching over the tube.	No. 3

1. *S. purpurea*, L. **SIDE-SADDLE FLOWER. PITCHER PLANT. HUNSMAN'S CUP.** Common in bogs and mossy swamps from New Eng. to Minn. south to Ky. and east of the Alleghanies to Fla. Leaves pitcher or ewer-shaped, short, 4' to 9' long, rosulate, curved, ascending, inflated most near the middle and tapering below into a petiole; red or greenish with purple veins. Wing broad. Hood erect, broadly heart-shaped. Surface smooth without, with stiff hairs pointing downward on the inside. Scape 12' to 14' high, supporting a single, nodding flower, usually purple, but varying to pink and green, with fiddle-shaped petals curved inwards over the style. As in all the species, the leaves usually contain water and drowned insects. June.

2. *S. flava*, L. **YELLOW TRUMPET LEAF. TRUMPETS. WATCHES.** In low pine barrens from N.C. to Fla. west to La. Leaves erect, tall, 1° to 3° high, trumpet-shaped, the slender tube enlarging very gradually to the top. Wing narrow, linear, or almost wanting. Hood erect, roundish, narrowed below. Scape tall, equaling the leaves. Flowers yellow, with long and drooping petals. April.

3. *S. variolâris*, Mx. **SPOTTED TRUMPET LEAF.** In low pine barrens from N.C. to Fla. and westward. Similar to the preceding in the shape of the leaf and the color of the flower. But its leaf, only 6' to 12' high, is broadly winged, spotted with white near the top, and the mouth of the tube is covered by the overhanging, concave hood. The flower, 2' across, is on a scape shorter than the leaves. May.

N.B.—One other pitcher plant, *S. peltacina*, and two other trumpet-leaf plants, *S. rubra* and *S. Drummondii*, also occur in the swamps of the southeastern U.S., for which see some fuller flora.

ORDER 8. PAPAVERACEÆ — POPPY FAMILY

Herbs, with alternate, exstipulate leaves, regular, hypogynous, polyandrous flowers, and usually a milky or colored, narcotic or acrid juice. Flowers mostly solitary, with long peduncles. Sepals 2, rarely 3, caducous. Petals 4 to 12, imbricated, soon deciduous. Stamens a multiple of 4, rarely as few as 16. Ovary compound. Stigmas 2 or more. Pod many-seeded, with 2 or more parietal placentæ.

Key to Genera

Juice red. Flowers white, solitary	SANGUINARIA	I
Juice red. Flowers white, panicle	BOCCONIA	VII
Juice and flowers yellow. Pods prickly	ARGEMONE	II
Juice and flowers yellow. Pods bristly	STYLOPHORUM	III
Juice and flowers yellow. Pods rough, 2-celled, 6' to 9' long	GLAUCIUM	*
Juice and flowers yellow. Pods smooth, 1-celled	CHELIDONIUM	IV
Juice white, milky	PAPAVER	V
Juice watery, leaf-like calyx, falling off whole	ESCHSCHOLTZIA	VI

* See fuller flora for this genus.

BRIEF FLORA — 3

I. SANGUINÀRIA, L. A low, smooth, stemless perennial, exuding from every part, when broken or bruised, an orange-red juice, with a thick, fleshy, horizontal, premorse rootstock, a large, palmately lobed, glaucous leaf, and a solitary, white flower on a scape. Genus monotypic, confined to eastern N.A.

1. S. Canadénsis, L. BLOODROOT. RED PUCCOON. Common in rich, open woods from Me. to Neb. south to Ark. and Fla. Sepals 2, caducous. Petals 8 to 12, in 2 or 3 rows, soon falling, the inner petals shorter, so that, when 8 in all, and fully expanded, the flower has a strikingly square outline. Stamens many. Pod oblong, tapering at each end, 1-celled, 2-valved. Seeds many, crested. April, May.

II. ARGEMÒNE, L. PRICKLY POPPY. Glaucous, annual or biennial herbs, with yellow juice, sessile, pinnatifid, spiny-toothed leaves, and showy, yellow or white flowers. Sepals 2 or 3, prickly, caducous. Petals 4 to 6. Stamens many. Stigmas nearly sessile, 3 to 6, radiate. Pod oblong-ovoid, prickly, opening by valves at the top. Seeds crested.

1. A. Mexicana, L. MEXICAN OR PRICKLY POPPY. In waste places from Pa. and N.J. to Fla. and Tex. Stout, 1° to 3° high, usually branching and spiny. Leaves 5' to 8' long, with white blotches, spiny on the veins beneath. Flowers terminal and axillary, nearly or entirely sessile, 2' to 3' wide, yellow, sometimes cream-colored or white. June to Sept.

III. STYLÓPHORUM, NUTT. Low, perennial herbs, with stout rootstocks, yellow juice, pinnately divided or parted leaves, and solitary or clustered flowers. Sepals 2, hairy, caducous. Petals 4. Stamens many. Style conspicuous. Stigma 2 to 4-lobed. Pods bristly, ovoid, 1-celled, opening by 2 to 4 valves.

1. S. diphýllum, NUTT. CELANDINE POPPY. In damp woods from W.Pa. and Ohio to Tenn. and westward. Flowering stem 12' to 18' high, with two opposite, petioled leaves at the top, and 2 to 5 umbellately clustered, deeply yellow flowers 1' to 2' in diameter. The two stem leaves are light green and smooth, deeply pinnatifid into 5 to 7 ovate-oblong segments. The radical leaves are similar, but with the addition often of a pair of distinct but smaller leaflets below. Resembles the Celandine in flower and foliage. May.

IV. CHELIDÒNIUM, L. CELANDINE. A biennial or perennial, with acrid, saffron-yellow juice, brittle stem, pale green, pinnate or pinnately divided leaves, and small, yellow flowers, 3 to 6 together, in a loose, peduncled umbel. Sepals 2. Petals 4. Stamens 16 to 24. Style very short. Stigma 2-cleft. Pod smooth, linear, 1-celled, with 2 valves splitting upward from the base. Seeds crested. Genus monotypic, European and Asiatic.

1. C. mājus, L. Common in waste places by roadsides and near dwellings in the eastern U.S.; partially naturalized from Europe; erect, branching, 1° to 2° high, slightly hairy. Leaves thin, glaucous beneath; leaflets lobed, with rounded segments. Petals elliptical, very fugacious. A variety, *laciniatum*, has the leaves very much dissected. May to Aug.

V. PAPAVER, L. POPPY. Annual or perennial, Old World herbs, with milky juice, usually lobed or dissected leaves, and long-peduncled, nodding flower buds. Sepals 2, rarely 3. Petals 4, rarely 6, crumpled in the bud. Stamens many. Ovary imperfectly many-celled by the projection of the placenta. Pod globose or obovate, crowned by the peltate, 4 to 20-rayed stigma, beneath which the many minute seeds escape through pores. Juice narcotic, containing opium.

1. P. somniferum, L. OPIUM OR GARDEN POPPY. A smooth, glaucous annual, with clasping, wavy leaves, and globose capsules, cultivated in the U.S. for ornament, but in the Old World also for the juice of the young capsules, from which the opium of commerce is made. Stem erect, 1° to 3° high, slightly branching. Leaves ovate-oblong, cordate, coarsely lobed or toothed, 4' to 8' long. Flowers white, with a dark center, 3' to 4' wide. Cultivation produces a variety of colors with striped and fringed petals.

2. P. Rhœas, L. CORN POPPY. An annual, common in British grain (corn) fields and extensively cultivated in and escaped somewhat from gardens in the eastern U.S. Stem rough with bristly hairs, branching, many-flowered. Leaves pinnately parted, with the lobes serrate. Flowers large, deep scarlet, black-spotted, with two petals smaller than the others. Pod obovate. Many varieties in color and more or less double are cultivated. This species and the following are somewhat confused in the authorities. June, July.

3. P. dābium, L. SMOOTH-FRUITED CORN POPPY. A European annual of the gardens, somewhat naturalized from Pa. southward. Stems slender, about 2° high, rough with bristly hairs. Leaves pinnately parted, with incised divisions. Flowers smaller and of a lighter scarlet than those of No. 2. Capsules slender and smooth. June, July.

4. P. orientale, L. ORIENTAL POPPY. A perennial from Armenia, 3° to 4° high, with bristly-hairy stems and leaves, and deep scarlet flowers, the largest of the genus, 6' to 8' across, with a dark, purplish center. Leaves pinnate or pinnately parted, with the leaflets or divisions oblong-lanceolate and serrate. *Calyx with 3 sepals.* Capsule smooth, obovate. May to July.

5. P. nudicaule, L. ICELAND POPPY. A stemless, alpine perennial, of Siberia and the northern parts of America, varying remarkably in both its wild and its cultivated forms. Leaves all radical, glaucous, pinnate or pinnately cleft, with the segments finely cut into acute or obtuse divisions. Flowers 1' to 3' wide, orange, red, white, or yellow, solitary, on slender scapes 6' to 18' high. Capsule obovoid, thickly covered with bristly hairs. June, July.

VI. ESCHSCHÖLTZIA, CHAM. Hardy, ornamental, annual or perennial, smooth or smoothish herbs, from western North America, with dissected leaves, watery juice, and long-pedun-

pled, yellow or whitish flowers. Sepals 2, caducous, cohering by their edges, and forming a miter-shaped cap to the erect flower bud, which is pushed off whole by the 4 opening petals. Stamens many. Capsule 1-celled, long, slender-spindle-shaped, grooved. Receptacle top-shaped, or funnel-shaped with a projecting rim.

1. *E. Californica*, HOOK. CALIFORNIAN POPPY. A perennial, usually cultivated as an annual, 1° to 2° high, with petioled leaves, and saucer-shaped, *orange-yellow flowers* 2' to 5' across. Pod 3' to 4' long. *Receptacle funnel-shaped, with a rim* supporting the long-pointed, conical calyx. June to Sept.

2. *E. Douglassii*, BENTH. A showy annual, similar to the preceding, but with *pure yellow flowers*, a top-shaped receptacle without a rim, and a short-pointed, ovoid calyx. June to Sept.

VII. *BOCCONIA*. PLUME POPPY. Tall, exotic perennials, with orange-red juice, large, stalked, lobed, glaucous leaves and terminal panicles of many small flowers *without petals*.

1. *B. cordata*, WILLD. A stately and hardy plant, 5° to 8° high, from China and Japan. Leaves 7 to 9-lobed, roundish-cordate, deeply veined, reflexed. Flowers white, cream-colored, or pinkish, with 2 sepals and about 30 stamens, raised in plume-like clusters high above the thick foliage beneath. Summer.

ORDER 9. FUMARIACEÆ — FUMITORY FAMILY

Smooth, delicate herbs, with colorless juice, brittle stems, compound or dissected, usually alternate leaves, often with tendrils, and irregular flowers. Sepals 2, minute. Petals 4, irregular, in connivent pairs, the outer and larger with one or both spurred, the inner coherent above and covering the anthers and stigma. Stamens 6, hypogynous, in 2 sets opposite the outer petals; the anther of the middle stamen of each set 2-celled, of the lateral ones 1-celled. Ovary and pod 1-celled, indehiscent and 1-seeded, or 2-valved and many-seeded.

Key to Genera

Corolla 2-spurred; climbing	. . . . .	ADLUMIA	I
Corolla 2-spurred; not climbing	. . . . .	DICENTRA	II
Corolla 1-spurred; fruit a pod	. . . . .	CORYDALIS	III
Corolla 1-spurred; fruit a globose nut	. . . . .	FUMARIA	*

* See fuller flora for this genus.

I. *ADLUMIA*, RAF. A smooth, delicate, climbing, biennial vine, with tripinnate leaves and axillary panicles of pale

pink or purplish flowers. Petals permanently united into a slightly cordate, narrowly ovate, persistent corolla, 4-lobed at the apex, becoming spongy and inclosing the 2-valved, several-seeded pod. Filaments united below into a tube adherent to the corolla, but diadelphous above. Seeds crestless. Monotypic, confined to eastern N.A.

1. *A. cirrhosa*, RAF. CLIMBING FUMITORY. MOUNTAIN FRINGE. ALLEGHANY VINE. In moist woods and thickets from New Eng. to Wis. and southward, to Kan. and N.C. Weak and slender, many feet long, it climbs over high bushes by its slender leafstalks. Often cultivated June to Aug.

II. *DICÉNTRA*, BORKH. Perennial herbs, with ternately compound, stalked leaves and nodding flowers in racemes. Petals connivent, but scarcely coherent; the two outer spurred, the inner crested. Pedicels 2-bracted. Pod 10 to 20-seeded. Seeds crested.

Low and stemless; wild Nos. 1, 2, 3
With leafy stems; cultivated No. 4

1. *D. Cucullaria*, DC. DUTCHMAN'S BREECHES. A smooth, delicate, stemless plant, of rich woods from New Eng. and the Great Lakes to N.C. and Ky. Root a loose or scaly bulb of *small, reddish, grain-like tubers*. Leaves radical, with slender petioles and linear lobes. Scapes bearing 4 to 10 white or whitish, scentless flowers with yellow tips. *Spurs of the corolla divergent, long, straight, acute*. Crest of the inner petals inconspicuous. April, May.

2. *D. Canadensis*, DC. SQUIRREL CORN. Very like the preceding in range, foliage, and inflorescence, but different in the following: *root bearing yellow tubers resembling grains of Indian corn; spurs short, obtuse, rounded*; crest of inner petals prominent; flowers fragrant, greenish-white, tinged with pink or purple. April, May.

3. *D. eximia*, DC. WILD BLEEDING HEART. In rocky places from western N.Y. southward along the Alleghanies to N.C., Tenn., and Ga. Rootstock scaly. Leaves radical, but with larger and coarser divisions than those of the two preceding species. Scapes 6' to 10' high. Flowers oblong, heart-shaped, with very short, obtuse spurs, deep rose or purple, in compound racemes with cymous divisions. Blooms all summer. Often cultivated. June to Sept.

4. *D. spectabilis*, DC. SHOWY DICENTRA. BLEEDING HEART. A hardy exotic from Japan and China, with leafy stems, 1° to 2° high, the leaves much coarser and the flowers larger and more numerous than in any of our native species. Leaves stalked, bipinnate, with obovate, wedge-shaped segments. Flowers broadly heart-shaped, rose-purple, sometimes white, 1' long. Sepals caducous. May, June.

III. *CORÝDALIS*, VENT. Annual or biennial, caulescent herbs, with bipinnate, dissected leaves, and flowers in terminal and lateral racemes. Petals deciduous, upper one spurred at

the base. Style persistent. Pod 2-valved, linear or oblong, many or few-seeded. Seeds crested or ariled.

1. *C. glauca*, PURSH. PINK CORYDALIS. A very glaucous biennial, with erect stem, 6' to 2° high, and paniced racemes of rose-colored flowers with yellow tips. Common in rocky places from New Eng. to Minn. and southward to N.C. Spur short and blunt. Pod erect, slender, 1' to 2' long. May to Aug.

2. *C. aurea*, WILLD. GOLDEN CORYDALIS. A diffuse, finally ascending, branching biennial, 6' to 14' high, of shady and rocky slopes from Vt. to Pa. and westward. Flowers golden yellow, 6'' long, with a spur half its length. Outer petals keeled on the back without a crest. Pod spreading or drooping, becoming torulose. Seeds blunt-edged. April to July.

3. *C. flavula*, DC. PALE CORYDALIS. Common in rocky woods from N.J. and southern N.Y. to Minn. and southward. Flowers pale yellow, 3'' to 4'' long. Spur very short. Outer petals with a crested wing on the back. Seeds sharp-edged. April to June.

ORDER 10. CRUCIFERÆ—MUSTARD FAMILY

Herbs, with alternate, exstipulate leaves, pungent, watery juice, and regular, hypogynous, polypetalous, tetradynamous, cruciform flowers in racemes or corymbs. Sepals 4, deciduous. Petals 4, usually with a claw. Stamens 6, rarely fewer; the 4 upper and inner longer than the other 2. Pod 2-celled by a false partition between the 2 parietal placentæ, sometimes 1-celled. Seeds in 2 rows in each cell, but sometimes, by intercalation, apparently in one. Albumen none. Embryo variously folded or curved and characterized in descriptions of plants of this family as *accumbent*, *incumbent*, or *conduplicate*, for the explanation of which terms see paragraph below. The plants of this family are all more or less pungent, sometimes acrid, but never poisonous.

On account of the great similarity of the flowers, generic distinctions in this family are drawn almost entirely from the pods and seeds, and in the latter from the position of the cotyledons. These positions are either: *accumbent*, in which the radicle is bent against the edges of the cotyledons, as represented by the symbol (o =); *incumbent*, with the radicle bent against the back of one of the cotyledons, as in the symbol (o ||); or *conduplicate*, with the incumbent cotyledons also folded or bent around the radicle, as in the symbol (o >>).

Key to Genera

1. Pods terete, turgid, or 4-angled by a strong midrib. (3)
1. Pods flattened parallel to the broad partition, linear. (3)
1. Pods flattened parallel to the broad partition, oval, oblong, or orbicular. (4)
1. Pods flattened contrary to the narrow partition. (5)
1. Pods indehiscent; beaked **RAPHANUS** XVII
2. Pods linear, oblong, or globose, valves nerveless. Aquatic **NASTURTIIUM** I
2. Pods linear, valves 1 to 8-nerved **SISYMBRIUM** VII
2. Pods linear, beaked beyond the valves **BRASSICA** VIII
2. Pods turgid, obovoid or pear-shaped **CAMELINA** XII
3. Native plants. Stems with only 2 or 8 leaves **DENTARIA** III
3. Native plants. Stems leafy. Valves nerveless. Seeds wingless **CARDAMINE** IV
3. Native plants. Stems leafy. Valves nerved. Seeds winged **ARABIS** V
3. Exotic plants. Seeds winged. Lvs. acute. Fls. white to purple **MATTHIOLA** II
3. Exotic plants. Seeds wingless. Leaves obtuse. Flowers yellow, orange, etc. **CHEIRANTHUS** VI
4. Native plants **DRABA** XI
4. Exotic plants. Pods very large, flat. Fls. rather large, purple **LUNARIA** X
4. Exotic plants. Pods small. Flowers small, yellow or white **ALYSSUM** IX
5. Pod several-seeded, obcordate, triangular, wingless **CAPELLA** XIV
5. Pod several-seeded, obcordate, orbicular, winged **THLASPI** *
5. Pod 2-seeded, flat **LEPIDIUM** XV
5. Pod 2-seeded, double. Valves rugose, indehiscent **SENEBIERA** XVI
5. Pods 2-seeded. Flowers irregular. Petals unequal **IBERIS** XIII

* See Gray's Manual, or Britton's Manual.

I. NASTURTIIUM, R. BR. Herbs, growing mostly in water or in wet places, with yellow or white flowers, and usually smooth, pinnate or pinnatifid leaves. Pod a silique or a silicle, nearly or entirely terete; valves veinless. Seeds usually many, small, lens-shaped, in 2 rows. Cotyledons accumbent.

1. N. officinale, R. BR. WATER CRESS. A European, aquatic perennial, with small, white flowers in corymbs, and pinnate leaves, often cultivated for salad and extensively naturalized in brooks and springs. Stems branching, spreading, rooting from the lower joints, 6' to 12' long. Leaflets 3 to 11, rounded or oblong, obscurely toothed, the terminal one largest. Flowers 2" to 3" wide. Petals twice as long as the sepals. Pods linear, about 1' long, spreading, curving slightly upward. May, June.

2. N. palustre, DC. MARSH CRESS. A homely weed, with pinnatifid leaves and small, yellow flowers, common in shallow water or in wet places throughout the U.S. Stem smooth, erect, 1° to 3° high. Petals little longer than the sepals. Pod linear or oblong, curved, rather longer than the spreading pedicel. A variety, *hispidum*, has a hispid stem, with ovoid or globular pods. June to Sept.

3. N. Armoracia, FRIES. HORSE RADISH. A well-known, European garden perennial, escaped from cultivation, and naturalized in wet grounds. Root long and large, white, fleshy, acrid. Stem 2° to 3° high, smooth, branching. Radical leaves oblong, sinuate, crenate, about 1° in length, on long, thick petioles. Cauline leaves sessile, lanceolate, dentate, or crenate. Flowers white. Petals entire, much exceeding the sepals. Pods ellipsoid or nearly globular. Pedicels slender, ascending. June.

II. MATTHIOLA, R. BR. STOCK. Herbaceous or somewhat shrubby, ornamental, Old World plants, with oblong or

linear, hoary leaves, and large, generally fragrant flowers in racemes or spikes. Sepals erect, 2 of them saccate at the base. Petals with long claws and spreading limb. Silique nearly cylindrical or compressed. Stigmas connivent, thickened or horned at the back. Seeds as broad as the partition, winged, in 1 row. Cotyledons accumbent. Flowers white to purple.

1. *M. annua*, R. BR. TEN-WEEKS STOCK. A hardy, garden annual from southern Europe, with erect, branching stem, 1° to 2° high, blunt, lanceolate leaves, and variegated flowers in open, terminal racemes. June.

2. *M. incana*, R. BR. WALLFLOWER-LEAVED OR COMMON STOCK. A half-hardy perennial or biennial, usually treated as an annual in cultivation, native in the Levant and in western Europe, with branching, somewhat shrubby stem, erect, hoary, oblong-lanceolate leaves, and large, purple to violet flowers. The source of the Queen and Brompton Stocks. Flowers by cultivation varying much in color, and often double. Blooming later than No. 1.

III. DENTARIA, L. TOOTHWORT. PEPPERROOT. Perennial herbs, with fleshy, toothed, or scaly rootstocks of an agreeably pungent taste. Stem simple, leafless below, but bearing half-way up 2 or 3 petioled, ternate, or palmately laciniate leaves, and at the top a corymb or short raceme of rather large, white, pink, or purple flowers. Sepals converging. Petals much longer than the sepals. Siliques lance-linear, with the flat valves often opening elastically. Seeds in 1 row, ovate, thick, wingless. Cotyledons accumbent.

1. *D. diphylla*, L. TWO-LEAVED PEPPERROOT. Common in rich woods and wet meadows from Me. to Minn. and south to S.C. and Ky. Stem smooth, terete, about 1° high, with 2 ternate leaves nearly opposite above the middle. Leaflets ovate or oblong-ovate, short-stalked, coarsely crenate, the lateral ones oblique. Radical leaves similar, on long petioles. Flowers white. Pods about 1' long, with a slender style. Rootstock long, continuous, toothed. May.

2. *D. laciniata*, MUHL. In moist woods from Me. to Minn. south to Fla. and La. Stem similar to that of No. 1, but with the leaves generally 3, and whorled or nearly so, 3-parted, the lateral divisions often 2-lobed, and all lanceolate, toothed, and cut or gashed. Radical leaves often wanting. Rootstock moniliform. Flowers racemed, pink or purplish. Pods about 18" long, linear, with a long, slender style. April, May.

IV. CARDAMINE, L. BITTER CRESS. Small, erect or ascending, mostly smooth perennials, growing in low, rich or wet ground. Stems leafy. Flowers white or purple, in racemes or corymbs. Sepals slightly spreading. Pods linear, with valves veinless, flat, narrow, often opening elastically from the bottom. Seeds with slender stalks, in 1 row in each cell, wingless. Cotyledons accumbent.

1. *C. hirsuta*, L. **HAIKY OR SMALL BITTER CRESS.** An annual or biennial, common in wet places from Pa. to Mich. and southward to N.C. More or less hairy, with a somewhat branching, erect stem, 4' to 16' high, *from a rosulate cluster of pinnate, radical leaves.* Leaflets few or many, 5 to 11, alike or unlike, toothed or entire, roundish or otherwise, the terminal one largest and usually 3-lobed. Stem leaves few and near the base, with linear or oblong leaflets. Flowers small, white. Pods 1' long, erect.

2. *C. rhomboidea*, DC. **SPRING CRESS. BULBOUS CRESS.** A common, smooth perennial, of wet meadows and woods from Me. to Minn. and southward to Fla. and Tex. Stems simple or somewhat branching above, 8' to 18' high, erect or ascending, *from a tuberiferous rootstock.* Leaves all simple; radical ones *long-petioled*, roundish, slightly cordate, entire; those of the stem, except the lower ones, sessile, oblong, ovate or lanceolate, dentate or angled. Flowers white, showy, 6" wide. Petals 8 or 4 times as long as the sepals. Pods 1' long, erect. Style slender. Stigma capitate. Seeds round-ovate. April to June.

V. *ÁRABIS*, L. **ROCK CRESS.** Annual, biennial, or perennial, smooth or downy herbs, with *mostly simple leaves*, and white or purple flowers. *Radical leaves usually petioled; those of the stem sessile or clasping.* Pods linear, flattened; valves mostly 1-nerved, not opening elastically. Seeds mostly winged, in 1 row. Cotyledons accumbent.

1. *A. hirsuta*, Scop. **HAIKY ROCK CRESS.** A *rough-hairy*, sometimes nearly smooth biennial, with simple leaves and greenish-white flowers, common in low, rocky grounds from New Eng. to Minn. and southward to the mts. of Ga. Stem erect, 1° to 2° high, with oblong or lanceolate, entire or toothed, sagittate-clasping leaves. Radical leaves spatulate, obtuse, dentate, tapering to a margined petiole. Siliques and pedicels strictly erect, straight, 1' to 2' long. Style very short or none. Seeds in 1 row; when immature, slightly 2-rowed. May, June.

2. *A. lævigata*, Poir. **SMOOTH ROCK CRESS.** A tall, *smooth*, glaucous biennial, growing in rocky places from New Eng. to Minn. and southward to Ark. and Ga. Stem simple, upright, 1° to 3° high, with lanceolate or linear-lanceolate, sagittate-clasping leaves, the lower ones toothed, the upper entire. Radical leaves petiolate, obovate or spatulate, dentate. Flowers greenish, erect. Petals scarcely exceeding the sepals. Pods 3' to 4' long, very narrow, recurved and spreading. Seeds broadly winged. May.

3. *A. Canadensis*, L. **SICKLE POD.** A biennial, of woods and rocky hills and ravines from the Great Lakes to Ga. and westward. Stem 2° to 3° high, slender, terete, smooth above, downy below, with sessile, lanceolate leaves, pointed at both ends; those lower on the stem also toothed. Petals greenish-white, twice as long as the sepals. *Pods 3' to 4' long, scythe-shaped*, very flat, 2" wide, and pendulous on the hairy pedicels. Seeds 1-rowed, strongly winged. June to Aug.

VI. *CHEIRÁNTHUS*, L. **WALLFLOWER.** Erect, biennial or perennial, Old World herbs or undershrubs, with narrow, entire or toothed leaves, and large, yellow or purple flowers in racemes. Sepals erect, lateral ones saccate at base. Petals long-clawed, with spreading limb. Pods linear; valves with a strong midnerve. Seeds flat, in 1 row. Cotyledons accumbent.

1. **C. Cheiri**, L. A slightly pubescent and somewhat shrubby perennial from southern Europe, 12' to 30' high, with lanceolate, entire, acute leaves, 2' to 3' long, on angular branches, and fragrant flowers, 1' across, of various shades of yellow, red, purple, or brown, in long, terminal racemes. Not hardy in the northern parts of U.S. June.

VII. SISÝMBRIUM, Tourn. Annuals or biennials, with simple leaves and small yellow or white flowers. Sepals spreading. Petals clawed. Pod linear, flattish, angled or nearly terete; valves 1 to 3-nerved. Stigma small. Seeds oblong, wingless, in 1 or 2 rows in each cell. Cotyledons incumbent.

1. **S. officinale**, Scop. **HEDGE MUSTARD**. An unsightly, European annual, naturalized as a common weed in fields, roadside, and other waste places throughout the eastern U.S. Stem erect, 1° to 3° high, with spreading branches, runcinate leaves, and *small, pale yellow flowers succeeded by awl-shaped, nearly sessile, erect pods, 6'' long, pressed close to the stem.* May to Sept.

2. **S. canescens**, Nutt. **TANSY MUSTARD**. A hoary annual, of dry soils from Pa. and N.Y. to Ill. and southward to Fla. and Tex. Stem erect, 1° to 2° high, slender, with ascending branches, bipinnately divided leaves, 2' to 4' long, oblong in outline, and minute, yellow or yellowish flowers. Pods oblong-linear, 3'' to 6'' long, ascending, shorter than their spreading or horizontal pedicels. Seeds in 2 rows in each cell. June to Aug.

VIII. BRÁSSICA, Tourn. (**BRASSICA** and **SINÁPIS** of L.) **CABBAGE. TURNIP. MUSTARD**. Old World annuals and biennials, with yellow flowers, cultivated or running wild as weeds. Leaves various. Pods oblong or linear, somewhat terete or 4-sided, *ending in a 1-seeded or empty beak formed by the enlarged base of the persistent style*; valves 1-nerved. Seeds globose, wingless, in 1 row. Cotyledons conduplicate.

§ **SINÁPIS**. Plants green or only slightly glaucous when flowering . . . Nos. 1-4

§ **BRASSICA**. Plants glaucous-blue when flowering.

Leaves always glaucous-blue and fleshy . . . Nos. 5, 7

Leaves thin and green except when flowering . . . No. 6

1. **B. (or SINÁPIS) nigra**, Koch. **BLACK MUSTARD**. An erect, branching, smooth or pubescent annual, 2° to 7° high, with bright yellow flowers, 3'' to 5'' wide, and mostly more or less divided leaves. Lower leaves deeply pinnatifid with a slender petiole and 1 large, terminal lobe with 2 to 4 smaller ones, all dentate. Upper leaves sometimes sessile; the uppermost lanceolate and entire. Pods linear, 4-sided, about 6'' long, with 1-nerved valves, appressed with their slender pedicels against the stem and tipped with an empty beak. Seeds many, globous, dark, smaller and more pungent than those of White Mustard. June, July.

2. **B. (or SINÁPIS) álba**, Boiss. **WHITE MUSTARD**. An erect, hairy annual, 1° to 2° high, with leaves all more or less pinnatifid, and yellow flowers, 7'' to 9'' wide. Pedicels thick, spreading. Pods spreading or ascending, bristly, thick below, constricted between the few seeds with a

1-seeded, sword-shaped beak equaling the rest of the pod. Seeds large, light brown. June, July.

3. *B. Sinapistrum*, Boiss. (*SINAPIS ARVENSIS*, L.) WILD OR FIELD MUSTARD. CHARLOCK. An erect annual, 1° to 2° high, that has become a troublesome weed in grain fields from New Eng. to Pa. and westward. Branching above, it has a hairy stem and leaves, yellow flowers, and smooth, spreading or ascending pods, constricted between the large black seeds. Leaves resembling those of No. 1, but less pinnatifid. Flowers 6'' to 8'' wide. Pods strongly nerved, 6'' to 8'' long, with one third their length made up of the 2-edged, empty or 1-seeded beak. June to Aug.

4. *B. júncea*, Cossou. (*SINAPIS JUNCEA*, L.) INDIAN MUSTARD. A pale, smooth, somewhat downy, slightly glaucous annual from Asia, sparingly naturalized in waste grounds in N.H., Pa., Va., and Mich. Stem erect, 1° to 4° high. Leaves resembling those of No. 3. Flowers yellow, about 8'' wide. Pods 1' to 2' long, with one third their length the empty beak, nearly or entirely erect on slender ascending pedicels.

5. *B. oleràcea*, L. CABBAGE. A cultivated, culinary biennial from the Old World, with smooth, glaucous-blue, fleshy, strongly veined leaves closely packed together in a head on the top of a short, thick stem. The original plant grows wild on the sea cliffs of southern and western Europe, where it has large, thick, green or reddish, more or less glaucous, deeply lobed leaves spreading as in the headless cabbage or kale. CAULIFLOWER and BROCCOLI have the head made up of the compacted flower cluster.

6. *B. Ràpa*, L. TURNIP. A cultivated, field and garden biennial, with thin, green, rough-hairy, not glaucous, lyrate leaves. *Root a flattened tuber with whitish flesh.*

7. *B. campéstris*, L. RUTABAGA OR SWEDISH TURNIP. TURNIP-ROOTED CABBAGE. A plant more nearly allied to the cabbage than to the turnip. Leaves, except the earliest ones, smooth, thick, and glaucous-blue. *Root an elongated tuber, with a yellowish flesh, roots growing from its lower part, and a thick, leafy neck.*

IX. *ALYSSUM*, Tourn. Low, annual or perennial, Old World herbs, with small, white or yellow flowers in racemes or corymbs. Petals entire. Stamens sometimes toothed. Silicle oval or orbicular; valves nerveless, with margin flattened and center convex. Seeds wingless, 1 to 4 in each cell. Cotyledons accumbent.

1. *A. marítimum*, L. SWEET ALYSSUM. A spreading annual, 6' to 9' high, with light green, lanceolate or linear, entire leaves, and small, white, sweet-scented flowers in terminal and at length long racemes. Pod oval, 1 seed in each cell. June to Oct.

2. *A. saxátile*, L. ROCK ALYSSUM. MADWORT. A showy perennial, shrubby at base, with lanceolate, entire, hoary leaves, and yellow flowers in close corymbs. Pod obovate-orbicular, with 2 winged seeds. April, May.

X. *LUNÀRIA*, L. HONESTY OR SATIN FLOWER. Two erect, branching, Old World herbs, with large, simple, cordate leaves, large, purple flowers in terminal racemes or panicles, and large, oblong or elliptical, stipitate silicles with deciduous valves, and a thin, persistent satin-like partition. Seeds

winged, 2 to 4 in each cell. Cotyledons accumbent. Both species common in gardens and called "HONESTY" from the visibility of the seeds through the pods.

1. *L. annua*, L. (*L. BIENNIS*, DC.) COMMON HONESTY. An annual or biennial, hairy plant, 2° to 4° high, with pink-purple flowers, and *elliptic* or *broadly oval silicles*, 1' to 2' long, *obtuse at both ends*. Cultivated in country gardens and gathered for winter bouquets on account of their large, silvery or satin-like pods. May, June.

2. *L. rediviva*, L. PERENNIAL SATIN FLOWER. A plant differing from the preceding mainly in being *perennial* and in having the *Pods lanceolate and acute at both ends*. Much rarer in cultivation in U.S.

XI. DRÀBA, L. Low, tufted herbs, with simple, entire or toothed leaves, and white or yellow flowers mostly in racemes. Pods oval or oblong, sometimes linear, flat. Seeds wingless, 2 rows in each cell. Cotyledons accumbent.

1. *D. verna*, L. (*ERÓPHILA VULGARIS*, DC.) WHITLOW GRASS. A tiny but interesting, Old World annual, of earliest spring, naturalized in the eastern U.S. Leaves pubescent with stiff hairs, all radical, rosulate, oblanceolate, 6" to 12" long, slightly dentate toward the end. Scapes nearly smooth, erect or ascending, 1' to 4' high, lengthening in fruit. Flowers white, 1" to 2" wide, *with 2-parted petals*. Pods oblong-oval, 3" to 4" long, shorter than their ascending pedicels. Seeds many. March, April.

XII. CAMÉLINA, CRANTZ. Erect, annual herbs, with simple leaves, small, yellow flowers, and pear-shaped pods. Seeds oblong, wingless, several or many, 2-rowed in each cell. Cotyledons incumbent.

1. *C. sativa*. CRANTZ. FALSE FLAX. GOLD OF PLEASURE. An Old World weed, especially in flax fields, naturalized in some places in eastern U.S. Stem 6' to 2° high, straight, branching. Leaves lanceolate, entire or nearly so, sagittate, sessile above. *Pods numerous, pear-shaped, margined, 3" to 4" long, tipped with a slender, pointed style*. Pedicels long, ascending. Cultivated in Germany for the oil of its seeds. May.

XIII. IBÉRIS, L. CANDYTUFT. Old World, annual or biennial herbs or shrubby perennials, with simple, linear, lanceolate or obovate leaves, and terminal clusters of white or purple flowers, with the 2 *outer petals much larger than the 2 inner*. Silicles roundish, ovate, flattened at right angles with the partition, emarginate with the style in the notch; valves boat-shaped, winged. Cells 1-seeded. Cotyledons accumbent. Only the annual and perennial species are in ornamental cultivation.

1. *I. umbellata*, L. COMMON CANDYTUFT. A smooth annual, 6' to 12' high, from southern Europe, with lanceolate, acuminate leaves, the upper ones entire, the lower serrate. Flowers usually purple, but very

variable, in umbels, as well as the silicles. Said to be the first species introduced and called *Candytuft* from *Candia*, its home, and its tufts of flowers. June, July.

2. *I. amara*, L. BITTER CANDYTUFT. An annual from western Europe and England, with white flowers in corymbs becoming racemes. June, July.

XIV. CAPSÉLLA, MEDIC. Erect, pubescent, annual herbs, with rosulate, radical leaves, small, white, racemed flowers, and obcordate, triangular silicles, flattened at right angles to the narrow partition. Valves boat-shaped, keeled, wingless. Seeds many, small. Cotyledons incumbent.

1. *C. Bursa-pastoris*, MOENCH. SHEPHERD'S PURSE. A very common weed, naturalized from Europe, and said to be "distributed as a weed in all parts of the globe." Stem 6' to 20' high. Radical leaves 2' to 6' long, more or less pinnately lobed on margined petioles. Stem leaves small, few, lanceolate, entire or dentate, auricled at base and sessile. Pod 2" to 4" long, smooth, emarginate, with the style in the notch. April to Sept.

XV. LEPÍDIUM, R. BR. PEPPERWORT. PEPPERGRASS. Mostly erect herbs, with small, white or greenish, sometimes incomplete flowers in lengthening racemes, and oblong or roundish pods flattened contrary to the partition, with dehiscent, boat-shaped, keeled valves. Petals sometimes wanting. Some of the stamens often lacking. Seeds pendulous, 1 in each cell. Cotyledons incumbent, or in No. 1 accumbent.

1. *L. Virginicum*, L. WILD PEPPERGRASS. A common weed, in fields and by roadsides from the Great Lakes to the Gulf of Mexico. An annual, 10' to 15' high, with its principal leaves radical, rosulate, and obovate in outline, tapering from a large, terminal lobe more or less toothed or incised through several pairs of smaller ones to a petiole. Stem leaves linear or lanceolate, and either entire or more or less toothed or incised. Flowers and pods very many, in panicked racemes. Flowers very small, with only 2 stamens, and the upper ones sometimes without petals. Pods orbicular, slightly winged at the emarginate top. Cotyledons accumbent. June to Oct.

2. *L. rudérale*, L. NARROW-LEAVED OR ROADSIDE PEPPERGRASS. A less common annual than No. 1, but naturalized along roadsides and about cities from Me. to Tex. and in dry fields in Mich., Ind., and Mo. Its radical and lower stem leaves are 1 to 2-pinnatifid, upper ones linear. Flowers apetalous and diandrous. Pods broadly oval, notched, wingless. June to Oct.

3. *L. campéstre*, R. BR. COW CRESS. YELLOWSEED. A European annual, naturalized from New Eng. to Va. and a troublesome weed in the Middle States. Stem strictly erect, branching above, downy, 6' to 15' high, with oblong-spatulate, usually entire, radical leaves, and entire or denticulate stem leaves clasping the stem by a sagittate base. Pods broadly ovate, notched, broadly winged at the top, and very numerous, in long, dense racemes. June, July.

4. *L. sativum*, L. GARDEN CRESS. A European annual, cultivated in gardens as a salad. Stem slender, branched, 1° to 2° high. Leaves

variously divided; lower ones pinnately, with the segments pinnately parted and toothed; upper ones entire or incised. *Pods oval, conspicuously winged all around.* July.

XVI. SENEBIÈRA, DC. WART CRESS. SWINE CRESS. Low, diffuse or prostrate, annual or biennial herbs, with mostly pinnately divided leaves and minute, white or whitish flowers. Stamens 2, 4, or 6. Pods small, rugose, double, flattened contrary to the narrow partition; the 2 cells indehiscent, separating at maturity from the partition as 1-seeded nutlets. Cotyledons incumbent.

1. *S. didyma*, PERS. (*S. PINNATIFIDA*, DC.) **LESSER WART CRESS.** A prostrate herb, spreading circularly on the ground like the carpet weed (*Mollugo*), found in waste places from New Eng. to Fla. and Tex.; very common in the Southern States. Leaves deeply pinnatifid, with the lobes toothed on the upper edge. Pods pitted, notched at both ends. March to May.

XVII. RÂPHANUS, L. RADISH. Erect, annual or biennial herbs, with lyrate leaves, showy, rose-lilac, white, or yellow flowers, in loose, terminal racemes, and *tapering, indehiscent pods*. Sepals erect. Petals obovate, clawed. Siliques terete, oblong or linear, tapering upward, several-seeded, spongy or constricted between the seeds. Seeds large, globous, in 1 series. Cotyledons conduplicate.

1. *R. sativa*, L. **GARDEN RADISH.** A well-known, Old World vegetable, cultivated everywhere. Stem 2° to 4° high, branching. Lower leaves petioled, lyrate. Flowers white, pink, or purplish. *Pod 1' to 2' long, closed, thick, fleshy, acuminate, 2 to 3-seeded*, not longitudinally grooved, and very little, if at all, constricted between the seeds. Root spindle-shaped or turnip-shaped. June to Aug.

2. *R. Raphanistrum*, L. **WILD RADISH.** A European weed, naturalized in fields and waste places from New Eng. to Pa. Similar to the preceding in foliage, size, and habit, but differing in root, flowers, and pods. *Root slender and freely branching. Flowers yellow, becoming white or purplish. Pods narrow, long, 3 to 8-seeded, constricted between the seeds and grooved lengthwise.* June, July.

ORDER 11. CAPPARIDACEÆ — CAPER FAMILY

Herbs, shrubs, or, rarely, trees, with acrid, watery juice, alternate, simple or palmately compound leaves, and solitary or racemed, hypogynous, *cruciform flowers*. Sepals 4. Petals 4, usually with claws. *Stamens 6 or more, but not tetradynamous.* Ovary often stipitate, and in our species

becoming a 1-celled pod, with 2 parietal placentæ, and many kidney-shaped seeds. Albumen none. Embryo coiled.

Key to Genera

Stamens 6. Pod on a long stipe	CLEOME I
Stamens 8 to 32. Pod sessile or short-stiped	POLANISIA II

I. CLEOME, L. SPIDER FLOWER. Herbs or shrubs, with simple or digitate leaves, and showy, white, yellow, or purple, racemed or solitary flowers. Sepals 4, sometimes connate at base. Petals 4. Stamens 6, sometimes 4. Ovary stipitate, glandular at base. Pod oblong or linear, many-seeded.

1. *C. púngens*, WILLD. GIANT SPIDER PLANT. A tall, clammy, pubescent, strong-scented, cultivated annual or biennial from the West Indies, with a simple stem, 3° to 4° high, digitately 5 to 7-foliate leaves on long petioles, and curious, purple, rose-colored, or white flowers in bracted racemes. Sepals distinct. Petals on slender claws. *Stamens 6, purple, twice as long as the petals and spreading. Ovary on a very long stipe.* Leaflets elliptic-lanceolate. A pair of stipular spines under the petioles gives the specific name "pungens" (prickly). July.

2. *C. integrifolia*, TORR. AND GRAY. ROCKY MOUNTAIN BEE PLANT. A smooth annual, growing along streams in Ill. and Minn. to Kan. and westward, often cultivated in gardens for bees. Leaves 3-foliate, leaflets lanceolate to oblong. Flowers pink to white. Petals 3-toothed, without claws. July to Sept.

II. POLANISIA, RAF. Ill-smelling, mostly tropical or sub-tropical annuals, with clammy, glandular hairs, digitately compound, rarely simple, leaves, and yellowish or whitish flowers in leafy racemes. Sepals 4, distinct. Petals usually clawed, emarginate. Stamens 8 to 32, unequal. Pod linear or oblong, sessile or barely stiped.

1. *P. graveolens*, RAF. CLAMMY WEED. A strong-scented, clammy herb, of gravelly shores from western Vt. to southern N.Y. and Pa. and westward to Kan. Stem 6' to 18' high, branching. Leaves with glandular petioles, and 3 elliptic-oblong, entire leaflets, 12" to 18" long. Flowers in terminal racemes. Sepals purplish. Petals yellowish-white, clawed, emarginate. Stamens purplish, about 11, little longer than the petals. Pods lanceolate, slightly stiped. June to Aug.

ORDER 12. CISTACEÆ—ROCK-ROSE FAMILY

Herbs or low shrubs, with simple, mostly entire leaves, and regular, hypogynous flowers. Sepals 5, persistent, the 3 inner twisted in the bud, the 2 outer smaller and bract-like, or wanting. Petals 3 or 5, sometimes wanting, twisted in the bud contrary to the sepals. Stamens few

or many, distinct; anthers short, innate; filaments slender. Ovary 1-celled or partially 3-celled. Style but 1 or none. Capsule 1-celled, 3 to 5-valved, with as many parietal placentæ, each in the middle of the valve. Seeds few or many, albuminous. Embryo curved.

Key to Genera

Petals 5, large or wanting. Style none. Stigma capitate . . .	HELIANTHEMUM I
Petals 5, minute. Style filiform. Shrubs	HUDSONIA *
Petals 3, small, greenish or purplish, withering-persistent	LECHEA *

* See fuller floras of Gray, Wood, Britton, etc.

I. HELIANTHEMUM, Tourn. ROCKROSE. Low herbs or somewhat shrubby plants, mostly with fugacious, yellow flowers, and sometimes with later, smaller, apetalous ones. Petals 5, wrinkled in the bud, large and yellow in the earlier flowers, small or wanting in the later. Stamens and seeds numerous in the former, few in the latter. Stigma sessile or nearly so, capitate, 3-lobed. Capsule 1-celled, 3-valved.

1. H. Canadense, Mx. FROSTWEED OR FROST PLANT. A plant found in dry, gravelly, or sandy soil from Me. to Minn. and southward to N.C. and Ky. Stem simple at first, 6' to 12' high, producing later ascending branches which overtop it. Leaves lanceolate-oblong, 8" to 12" long, green above, hoary beneath. Earlier flowers petal-bearing, pediceled, solitary, bright yellow, 1' wide, lasting but one day, their capsules ovoid or obovoid, 3" to 4" long. Later flowers apetalous, clustered, axillary, nearly sessile, their capsules only 1" or less in length. Crystals of ice which sometimes form at the base of the stem in late autumn give the plant its common name *Frostweed*. May to Sept.

2. H. Carolinianum, Mx. A hairy plant, common in dry, sandy soils from N.C. to Fla. and westward. Stems ascending from a shrubby base, 8' to 12' high. Leaves short-petioled, lanceolate, acute, denticulate, the lowest obovate. Flowers all large and petal-bearing, 1' wide, solitary, 1 to 4, on pedicels above the axils. March, April.

ORDER 13. VIOLACEÆ — VIOLET FAMILY

Herbs or shrubs, with alternate or radical, simple, stipulate leaves, and clustered or solitary, mostly irregular flowers. Sepals, petals, and stamens in 5's, and hypogynous. Petals imbricated in bud, often twisted; lower one larger, or spurred. Stamens usually on a hypogynous disk, connivent over the pistil by their adnate, introrse anthers. Filaments short, dilated, prolonged beyond the anthers. Style single. Ovary of 3 carpels, becoming a 1-celled capsule, with 3 parietal placentæ, and when ripe splitting

loculicidally into 3 valves, with their several-seeded placentæ along their middle.

I. VIOLA, L. VIOLET. Low, mostly perennial herbs, with alternate or radical leaves, and solitary flowers on scapes or axillary peduncles. Sepals 5, unequal, auricled at base. Petals 5, irregular, the lower one spurred at base, the two lateral opposite and equal. Stamens 5, short, included. Anthers connate, two of them with spurs projecting into the spur of the corolla. Peduncle angular, recurved at the top, giving the flower a reversed position. Besides the ordinary flowers, others, known as *cleistogamous flowers*, are produced by some species, especially the stemless ones, later in the season, on runners or on short peduncles, often under the dead leaves and soil. They are without petals and never open, but, fertilized in the bud, are more fruitful than their conspicuous petal-bearing companions. All the species here given are perennials, except No. 16, which is an annual or biennial or short-lived perennial.

Stemless.	Flowers yellow	No. 1
	Flowers white, often with petals veined	Nos. 2, 3, 4
	Flowers blue, beardless	Nos. 5, 6
	Flowers blue, bearded	Nos. 7, 8, 9, 10
Leafy-stemmed.	Flowers yellow	No. 11
	Flowers not yellow; stipules entire	No. 12
	Flowers not yellow; stipules toothed or fringed	Nos. 13, 14, 15
	Flowers not yellow; stipules very large, lyrate-pinnatifid	No. 16

1. V. rotundifolia, Mx. ROUND-LEAVED V. Small, early, in cold woods from Me. to Minn. and south along the Alleghanies to Tenn. Leaves round-ovate, cordate, slightly serrate or crenate, 6" to 2' wide when in flower, 3' to 5' wide, *shining, lying flat on the ground in summer*. Flowers small. Petals pale yellow. Rootstock later in the season producing stolons which bear cleistogamous flowers. April, May.

2. V. lanceolata, L. LANCE-LEAVED V. Grows in wet places from the Great Lakes to the Gulf of Mexico. Leaves smooth, lanceolate, erect, tapering to a long petiole. Rhizome slender, creeping. Flowers small. Petals white, with blue lines. Cleistogamous flowers on short, erect peduncles. March to May.

3. V. primulæfolia, L. PRIMROSE-LEAVED V. In damp places from New Eng. to Fla. toward the coast. Similar to No. 2 in rootstock and both kinds of flowers, but with oblong-ovate leaves and the blade often decurrent on the long petiole. April to June.

4. V. blanda, Willd. SWEET WHITE V. In wet and damp places from the Great Lakes to the Carolinas and westward. Rhizome slender, creeping. Leaves smooth or slightly pubescent, roundish, cordate or kidney-shaped, crenate. *Flowers fragrant*, small, white with purple veins, mostly beardless. Cleistogamous flowers on short, ascending peduncles. April, May.

5. V. odorata, L. SWEET OR ENGLISH V. A European perennial, occasionally found escaped from cultivation in northeastern U.S. Stems downy or smooth, growing in tufts from a thick rootstock, and sending out long, leafy, creeping stolons which late in the season bear cleistogamous flowers. Leaves broadly ovate, cordate, crenate, 1' to 2' wide, on

petioles 2' to 5' long, with lanceolate, toothed, glandular stipules. *Flowers on bracted peduncles, fragrant, 6'' to 10'' wide. Petals beardless, blue, varying in cultivation to white. Peduncles of apetalous flowers short and decumbent. April, May.*

6. *V. pedata*, L. BIRD-FOOT V. In dry and light soils from Me. to Minn. and south to Fla. and Mo. Rootstock erect, short, thick, premorse, without runners. Leaves on long petioles, pedately 5 to 11-parted, with the lanceolate-linear segments entire or toothed. Flowers on long scapes, large, pale blue, the *petals all beardless, the two upper ones often deep violet with yellow base as in the garden pansy.*

7. *V. pedatifida*, G. DON. (*V. DELPHINIFOLIA*, NUTT.) PRAIRIE VIOLET. In rich prairies from Ill. to Kan. and Minn. Leaves pedately 5 to 7-parted, with linear, 2 to 3-cleft segments. Flowers smaller than in No. 6, bright blue, with *bearded lateral petals. March to May.*

8. *V. palmata*, L. COMMON BLUE V. Common everywhere from Me. to Ga. and west to Minn. and Ark. Smooth to downy and hairy. Rootstock thick, fleshy, without runners. First leaves round-heart-shaped or kidney-shaped and crenate, with the edges rolled inward when young; the later varying greatly, being lobed or parted, palmately or hastately, with linear to obovate segments. Flowers violet to purple. Lateral petals bearded. Apetalous flowers on horizontal peduncles. Var. *cucullata*, GRAY. Later leaves not lobed or parted. Both forms vary greatly in the size and shape of the leaves, as well as in the color and size of the flowers, which may be deep or pale blue or even white. April, May.

9. *V. villosa*, WALT. SOUTHERN WOOD V. Common in dry, sandy woods from Pa. and N.J. to Fla. Rootstock short, thick. Leaves short-petioled, prostrate, roundish-ovate, cordate, crenate, dark green and purple-veined above, purplish beneath, *downy with appressed hairs, but not villous. Flowers small, petals blue, generally bearded. Apetalous flowers on horizontal or spreading peduncles. March, April.*

10. *V. sagittata*, AIT. ARROW-LEAVED V. In sandy places, dry or moist, from Me. to Minn. south to Ga. and Tex. Rootstock short, stout, without runners. Smooth or slightly pubescent. Earlier leaves on short, margined, the later on long, naked petioles; the blades of both varying from arrow-shaped or halberd-shaped to oblong heart-shaped, ovate or lanceolate, serrate or denticulate, often cut-toothed toward the base. Scapes long. Petals rather large, purplish-blue with a white base; lateral ones sometimes all bearded. Spur short. Stigma beaked. April to June.

11. *V. pubescens*, AIT. DOWNY YELLOW V. Common in dry, stony woods from New Eng. to Minn. south to Mo. and Ga. *Pubescent or villous. Stem simple, erect, fleshy, somewhat triangular, 5' to 20' high, naked below, with a few leaves at the top. Leaves broadly ovate, cordate, denticulate, generally obtuse, on short petioles. Stipules large, ovate-lanceolate. Flowers bright yellow, with purple veins and bearded lateral petals. April to June.*

12. *V. Canadensis*, L. CANADA V. Common in hilly and mountainous regions from New Eng. southward along the Alleghanies. Stem simple or tufted, upright, 1° to 2° high, leafy from the base. Leaves smooth, heart-shaped, acuminate or acute, serrate; some orbicular. Stipules ovate-lanceolate, entire. Flowers large, on short peduncles, with pale-blue or white petals marked with purple lines inside and often tinged with purple outside; lateral ones bearded. Spur very short. Blooming all summer. May to Aug.

13. *V. striata*, AIT. PALE OR STRIPED V. In low grounds, moist woods, and meadows from western New Eng. to Minn. and southward to Ga., Ky., and Mo. Smooth, with tufted, angular, branching, erect or ascending stems, 6' to 12' high. Leaves roundish-ovate, cordate, finely

serrate; upper ones acute. *Stipules large, oblong-lanceolate, fringe-toothed.* Flowers large, on long, axillary peduncles, with cream-colored or white petals, the lateral ones densely bearded, *the lower one striate, with purple lines.* *Spur one fourth the length of the corolla.* April, May.

14. *V. canina*, L., Var. *Muhlenbergii*, GRAY. Dog V. Common in moist or damp, shady places as far south as N.C. and Ky. Low, 5' to 8' high, mostly smooth. Stems slender, simple or tufted, erect, ascending or decumbent, with later ones prostrate. Leaves heart-shaped or kidney-shaped, crenate, obtuse, or acute, about 1' in diameter. Stipules lanceolate, laciniately fringed. Flowers rather small, pale purple, rarely white, with lateral petals slightly bearded. Spur cylindrical, half as long as the petals. May to July.

15. *V. rostrata*, PURSH. LONG-SPURRED V. Common in moist woods or on shaded hillsides from New Eng. to Mich. and south in the mts. to Ga. and Ky. Smooth, low, 3' to 7' high. Stems slender, ascending. Leaves cordate, or lower ones kidney-shaped, about 1' wide, serrate; upper ones acute. Stipules large, lanceolate, laciniately fringed. Flowers rather large, with pale-violet petals marked with blue veins. Spur slender, very long, 6'', longer than the petals. May, June.

16. *V. tricolor*, L. PANSY. HEART'S-EASE. A European annual or sometimes biennial or perennial, common in cultivation and occasionally escaped in waste places. Stem angled, branching, 4' to 12' high. Leaves oblong-ovate above, ovate-cordate below, crenate, dentate, or entire. *Stipules very large, leaf-like and lyrate-pinnatifid.* Flowers large, normally with the two lateral petals white, the two upper (lower) purple, and the fifth striate; all yellow at base, but cultivation has varied the colors indefinitely. May to July. Var. *arvensis*, DC., the JOHNNY JUMP-UP of dry and sandy soils from N.Y. to Ga. and westward, has smaller, more slender, and less branching stems, and much smaller flowers, with petals little longer than the calyx. May.

ORDER 14. CARYOPHYLLACEÆ—PINK FAMILY

Herbs, with opposite, entire leaves, usually swollen joints, and regular, mostly symmetrical flowers. Sepals 4 to 5, persistent, distinct, or united into a tube. Petals 4 to 5, with or without claws, sometimes wanting. Stamens twice as many as the sepals, rarely only as many or fewer, hypogynous or perigynous. Styles 2 to 5, stigmatic along the inner side, or rarely united into one. Fruit a 1-celled (rarely 3 to 5-celled) capsule, opening by teeth or by valves. Seeds usually many, with a slender embryo curved or coiled around the albumen.

Key to Genera

- | | |
|--|-----------------|
| 1. Capsules 8-celled. A prostrate herb | MOLLUGO VIII |
| 1. Capsules 1-celled, 1-seeded | SCLERANTHUS VII |
| 2. Capsules 1-celled, 8 to many-seeded. (3) | |

2. Sepals united into a tube or cup. Petals with claws. (3)
 2. Sepals distinct. Petals without claws. (4)
 3. Calyx with scaly bracts at its base. Styles 2 **DIANTHUS** I
 3. Calyx without scaly bracts at its base. Styles 2 **SAPONARIA** II
 3. Calyx without scaly bracts at its base. Styles 3 (or 4) **SILENE** III
 3. Calyx without scaly bracts at its base. Styles 5 **LYCHNIS** IV
 4. Styles 5. Pod opening by 10 teeth **CERASTIUM** V
 4. Styles 3 (or 4). Pod opening by 6 (or 8) teeth **STELLARIA** VI

I. DIANTHUS, L. PINK. CARNATION. Ornamental, Old World, perennial, rarely annual, herbs, with terminal, clustered or solitary flowers and mostly narrow, grass-like leaves. Calyx tubular, striate, 5-toothed, with 2 or more imbricated bracts at the base. Petals 5, with long claws and mostly a notched limb. Stamens 10. Styles 2. Capsule 1-celled, stipitate, cylindrical or oblong, many-seeded, opening at the top by 4 or 5 teeth.

1. **D. Armèria, L. DEPTFORD PINK. WILD PINK.** A small annual, thoroughly naturalized in fields and woods from Me. to Md. and westward. Stem slender, erect, 6' to 15' high, with a few, nearly erect branches. Leaves hairy, linear, erect, 1' to 3' long, tapering to the apex from a sessile or clasping base. Flowers small, scentless, in terminal clusters. Bracts of calyx lanceolate-subulate. Petals rose-colored, dotted with white, crenate. June, July.

2. **D. barbatus, L. SWEET WILLIAM. BUNCH PINK.** An ornamental perennial, somewhat escaped from cultivation in the Eastern and Middle States. Leaves large, lanceolate, 3' to 5' long, narrowed to a sessile or clasping base. Flowers in round-topped cymes, with sharply toothed, bearded petals of various and variegated colors. Bracts of the calyx ovate-subulate. May to July.

3. **D. Caryophyllus, L. CARNATION. CLOVE PINK.** A smooth, ornamental, mostly indoor, perennial, with tufted, branching stems, 2° to 3° high, linear-awl-shaped, channeled, glaucous leaves, and solitary, terminal, fragrant flowers. Bracts of the calyx very short, broad-ovate. Petals very broad, beardless, crenate, originally (so alleged) flesh-color, whence the name "carnation," but varying under cultivation to every shade of pink, red, crimson, white, and yellow, as also to many variegated forms known as *Flakes*, *Bizarres*, *Picotees*, *Grenadines*, etc. More than 400 varieties have been named by florists.

4. **D. plumarius, L. GARDEN PINK. PHEASANT'S EYE.** A low, tufted, hardy perennial, 1° or more high, with small, linear, glaucous, rough-edged leaves, and solitary, terminal flowers, 2 or 3 on a stem. Petals white, pink, or variegated; throat hairy, *margin fringed*. The supposed original of the "Pheasant's Eyes" of Scotland with their not less than 300 enumerated varieties. June to Aug.

II. SAPONARIA, L. SOAPWORT. Old World annuals or perennials, with an ovoid or oblong-tubular, bractless calyx. Petals 5, with long, slender claws, and entire or emarginate limb. Stamens 10. Styles 2. Capsule oblong or ovoid, 1-celled, many-seeded.

1. *S. officinalis*, L. COMMON SOAPWORT. BOUNCING BET. A smooth, succulent perennial, with a white, fleshy, creeping rootstock, and stout, erect, clustered, leafy stems, 18' to 30' high, escaped from gardens and naturalized by roadsides and in waste places from New Eng. to Ga. Leaves oval-lanceolate, 2' to 4' long, 3 to 5-ribbed. Flowers in compact corymbs. Calyx cylindrical. Petals often double, flesh-colored, lilac or white, obcordate, with a scale crowning the top of the claw. The juice makes a lather with water; whence the name "soapwort." July to Sept.

III. *SILÈNE*, L. CATCHFLY. CAMPION. Annual, biennial, or perennial herbs, with solitary or clustered flowers. Calyx tubular or ovoid, swelling or inflated, bractless, 5-toothed, 10 to many-nerved. Petals 5, clawed, mostly crowned with a scale or scales at the top of the claw. Stamens 10. Styles 3, rarely 4. Capsule 1-celled, or imperfectly 2 to 4-celled, opening at the top by 6 or 3 teeth; many-seeded.

Calyx inflated. Flowers white. Plant not sticky Nos. 1, 2

Calyx not inflated except by the growing capsule. (s)

a. Pubescent with viscid hairs. Flowers pink or red Nos. 8, 4, 5

a. Pubescent with viscid hairs. Flowers white No. 6

a. Smooth stems glutinous below the joints Nos. 7, 8

1. *S. stellata*, Ait. STARRY CAMPION. An erect perennial, of woods and prairies from R.I. to Minn. south to S.C. and Ark. Stem 2° to 3° high, slender, pubescent. Leaves sessile, ovate-lanceolate, acuminate, with finely ciliate margins, 2' to 5' long, in whorls of 4. Flowers white, 7'' to 12'' broad, in a large open panicle. Calyx inflated, ovoid, loose, light green with dark green veins. Petals crownless, lacerately fringed. Stamens exserted. July, Aug.

2. *S. Cucubalus*, Wibel. (*S. inflata*, Smith.) BLADDER CAMPION. A smooth, glaucous perennial, of fields and meadows and along fences from New Eng. to Pa. and west to Ill. Stem erect, branching, 6' to 18' high. Leaves ovate-lanceolate or oblong, sometimes spatulate. Flowers white, 6'' to 10'' across, in loose, leafless, cymose panicles. Calyx much inflated, ovoid-globose, handsomely veined and netted. Petals 2-cleft, crown small or none. July.

3. *S. Pennsylvanica*, Mx. WILD PINK OR PENNSYLVANIA CATCHFLY. A low perennial, of dry, sandy, gravelly or rocky soils from Me. to Ga. and westward to central N.Y. and Ky. Stems tufted, decumbent, 4' to 12' high, viscid-pubescent, at least above, often smooth below. Radical leaves spatulate, obtuse or acute, 2' to 4' long, tapering to a ciliate petiole; those of the stem lanceolate. Cymes terminal, few-flowered. Petals pink, wedge-shaped, notched, eroded, crowned. Calyx tubular, becoming club-shaped with the growth of the capsule, erect in fruit, hairy, very glutinous. April to June.

4. *S. Virginica*, L. FIRE PINK. VIRGINIA CATCHFLY. A slender perennial, of fields and open woods from western N.Y. and southern N.J. to Ga. and west to Mo. and Minn. Stem erect or ascending, branching, 1° to 2° high, viscid-pubescent. Leaves thin; radical and lower ones spatulate on fringed petioles, 3' to 5' long; upper ones sessile, small, remote, oblong-lanceolate, acute. Cymes loose, few-flowered. Calyx tubular-club-shaped, becoming ovoid-club-shaped and nodding in fruit. Flowers deep crimson, 12'' to 18'' across, with oblong, bifid, crowned petals. June to Aug.

5. *S. régia*, Sims. ROYAL OR SPLENDID CATCHFLY. A large perennial, of the prairies from Ohio to Mo. and south to Ala., often cultivated. Stem simple or somewhat branching, erect, stout, rigid, 3° to 4° high, roughish, slightly viscid. Leaves ovate-lanceolate, acute or acuminate, thickish, sessile except the lowest. *Flowers deep scarlet, large, numerous, short-stalked, in cymes forming a strict panicle.* Petals spatulate-lanceolate, crowned. Calyx tubular, slightly swollen in fruit. July.

6. *S. noctiflora*, L. NIGHT-FLOWERING CATCHFLY. An Old World annual, naturalized as a weed in cultivated grounds and waste places from Me. to Fla. and Mo. Stem erect, stout, simple or dichotomously branching, 1° to 3° high, viscid-hairy. Lower leaves spatulate, 2' to 5' long; upper ones lanceolate, sessile, 1' to 3' long. *Flowers white or pinkish, rather large, few, in a loose, forked panicle, very fragrant, opening at night or in cloudy weather.* Petals bifid, crowned. Calyx tubular, ovoid in fruit, with long, awl-shaped teeth. July to Sept.

7. *S. antirrhina*, L. SLEEPY CATCHFLY. A slender annual, of dry soils and roadsides from Canada to the Gulf of Mexico. Stem erect or ascending, simple or branching above, nearly smooth, *glutinous below the upper joints.* Leaves oblanceolate, 1' to 2' long below; linear and bract-like above. *Flowers panicled, few, small, pink, with obcordate, crowned petals.* Calyx ovoid, with acute teeth. June to Sept.

8. *S. Arméria*, L. SWEET WILLIAM OR GARDEN CATCHFLY. A smooth, glaucous, Old World annual, cultivated in gardens and naturalized in waste places from Me. to Mich. and south to N.J. and Pa. Stem erect, branching, 12 to 18' high, *glutinous below each joint.* Radical leaves oblanceolate, 2' to 3' long; those of the stem ovate-lanceolate. Flowers purple or pink, about 6'' across, in flat, terminal, compound cymes. *Petals notched, crowned with subulate scales.* Calyx club-shaped. June, July.

IV. *LÝCHNIS*, L. Mostly Old World, ornamental herbs, closely allied to those of the preceding genus. Calyx bractless, inflated, tubular or ovoid, 5-toothed, 10-nerved. Petals 5. with narrow claws, entire, bifid or laciniate blades and usually crowned. Stamens 10. Styles 5, rarely 4. Capsule 1-celled, or 5 to 4-celled at base, opening by twice as many teeth or just as many.

1. *L. Githàgo*, Lam. CORN COCKLE. A tall annual, naturalized as a handsome weed in grainfields. Stem erect, simple below, forked above, 2° to 3° high, pale green, villous with appressed hairs. Leaves linear-lanceolate, 3' to 5' long. Flowers few, large, on long peduncles. Petals broad, emarginate, crownless, dull purple, much exceeded in length by the long, linear, leaf-like, and deciduous lobes of the calyx. Capsule 1-celled. Seeds many, purplish-black, angular, roundish. July.

2. *L. coronària*, L. MULLEIN PINK. ROSE CAMPION. An ornamental biennial or perennial from Italy, densely covered with white, woolly hairs. Stem erect or ascending, 1° to 3° high, thick, simple or dichotomously branching. Leaves, at least above, oblong-lanceolate, sessile. Flowers few, on long peduncles, crimson. Petals broad, emarginate, crowned with a bifid scale. Calyx bell-shaped. Varieties have also white flowers. July.

3. *L. Chalcedónica*, L. A tall perennial from Russia, common in country gardens. Stem somewhat hairy, 2° to 3° high, simple or nearly so. Leaves dark green, ovate or ovate-lanceolate, 2' to 5' long, somewhat

cordate at base, clasping. Flowers scarlet or brick-red, in dense, terminal, corymbed heads. Petals 2-lobed, crowned with 2 teeth at the top of the claw. June, July.

V. CERÁSTIUM, L. MOUSE-EAR CHICKWEED. Annual or perennial, usually more or less hairy herbs, with white flowers in terminal, dichotomous cymes. Sepals 5, rarely 4. Petals same in number as the sepals, bifid, or wanting. Stamens twice as many as the sepals or fewer. Styles 5 or 4, opposite the sepals. Capsule cylindrical, membranaceous, usually elongated and curved, many-seeded, opening at the top by 10 or 8 teeth.

1. C. vulgatum, L. LARGER MOUSE-EAR C. A pale green, clammy-hairy perennial, common in fields and waste grounds east of the Miss., largely naturalized from Europe, but probably native in the extreme northern parts. Stems spreading, 6' to 18' long. Leaves oblong and spatulate-oblong. Upper bracts with scarious margins. Flowers in cymes, with pedicels at first shorter but finally much longer than the sepals, which are 2" to 3" long and about equal to the bifid petals. May to Sept.

VI. STELLÀRIA, L. CHICKWEED. STARWORT. Annual or perennial, mostly diffuse or ascending herbs, with white flowers in terminal or rarely axillary cymes. Sepals 5, sometimes 4. Petals the same number and 2-parted, or none. Stamens 10, 8, or fewer. Styles usually 3, sometimes 4 or 5. Pod ovoid, 1-celled, opening by as many 2-parted valves as there are styles. Seeds several or many.

1. S. média, SMITH. COMMON CHICKWEED. A low, decumbent, Old World annual, naturalized as a common weed almost everywhere in moist, cultivated ground from Me. to Tex., and flowering from earliest spring to latest autumn. Stems weak, spreading, 4' to 12' long, marked lengthwise with 1 or 2 fine, hairy lines. Leaves ovate or oblong, 3" to 2' long, lower ones sometimes on ciliate petioles. Flowers 2" to 4" wide, with the 2-parted, white petals shorter than the sepals. Stamens 3 to 10. March to Oct.

2. S. pùbera, Mx. GREAT CHICKWEED. A low, branching perennial, 6' to 10' high, growing in moist or shaded, rocky places from N.J. to Ind. and south to Ga. and Ala. Stem and branches smooth except 1 lateral or 2 opposite, delicate, hairy lines running lengthwise. Leaves sessile, oblong or elliptical, 1' to 2' long, acute. Flowers, in leafy cymes, 5" to 7" across, with the conspicuous, 2-parted white petals much exceeding the lanceolate, often white-edged, sepals. Styles 3. Stamens 10. April to June.

3. S. longifolia, MUHL. LONG-LEAVED STITCHWORT. A smooth perennial, of moist, grassy places from Me. to Ky. Stem erect or ascending, weak, usually supported by other plants, 8' to 16' high, slender, brittle, often rough-angled. Leaves linear, acute or nearly so, 1' to 2' long. Bracts lanceolate, scarious. Flowers many, white, 3" to 5" across, on slender, spreading pedicels, in naked, peduncled, terminal, or finally lateral cymes. Petals white, 2-parted, usually longer than the lanceolate, acute, 8-veined sepals. June, July.

VII. SCLERÁNTHUS, L. Low, Old World annuals, with exstipulate, awl-shaped leaves, and very small, greenish, clustered, apetalous flowers. Calyx bractless, 5-lobed, hardened below into a cup. Stamens 10, sometimes 5, on the calyx tube. Styles 2, distinct. Fruit a smooth, 1-seeded utricle, inclosed by the calyx.

1. S. ánnuus, L. KNAWEI. GERMAN KNOTGRASS. A homely weed, with long roots and prostrate or spreading branches, 3' to 5' long, smooth or slightly pubescent, naturalized in dry fields and roadsides near the coast from Me. to Fla.; specially common as far south as the Middle States. Leaves light-green, linear, acute, 2" to 12" long, opposite, sessile, nearly connate. Flowers minute, green, sessile in the axils. March to Oct.

VIII. MOLLÚGO, L. INDIAN CHICKWEED. Low, much-branched herbs, mostly annual, with whorled or sometimes alternate or radical leaves, and small, whitish, axillary, or cymose flowers. Sepals 5, united below, white inside. Petals wanting. Stamens hypogynous, 5, alternate with the sepals, or 3, alternate with the cells of the ovary. Capsule 3-celled, 3-valved, opening loculicidally, many-seeded.

1. M. verticilláta, L. CARPET WEED. A smooth, prostrate annual, of sandy river banks and cultivated grounds from Me. to Minn. south to Fla. and Tex. Stems jointed, branching, forming roundish patches, flat on the ground, often 2° in diameter. Leaves wedge-shaped or spatulate, obovate or linear, 6" to 12" long, unequal in size, clustered at the joints in whorls of 5 or 6. Flowers very small, white, axillary, on filiform pedicels. Capsule ovoid. Seeds reniform. June to Sept.

ORDER 15. PORTULACACEÆ—PURSLANE FAMILY

Succulent herbs, with entire, generally exstipulate leaves, and unsymmetrical, regular flowers. Sepals usually 2, rarely 3 or 5. Petals 5, sometimes wanting. Stamens hypogynous, 5 to 20, as many as the petals when opposite; otherwise varying in number. Ovary superior, 1-celled. Styles several, distinct or united below, stigmatic along the inner side. Pod 1-celled, opening by a lid, or by 3 valves. Seeds few or many.

Key to Genera

Stamens 7 to 20, perigynous. Pod opening by a lid	PORTULACA I
Stamens 5, attached to the base of the petals	CLAYTONIA II

I. PORTULACA, Tourn. PURSLANE. Low, annual or perennial, fleshy herbs, with alternate or irregularly opposite

leaves, and purple, yellow, or pink flowers opening only in sunshine. Sepals 2, united below and cohering with the ovary. Petals 4 to 6, fugacious. Stamens 7 to 20, inserted with the petals on the calyx. Style 3 to 9-parted or -cleft. Pod globular, 1-celled, many-seeded, opening horizontally by a lid.

1. *P. oleracea*, L. COMMON PURSLANE. A smooth, prostrate, reddish-stemmed annual, branching freely from a strong, central root, apparently native in the southwestern U.S., but evidently naturalized in the northern and eastern portions from Europe as a very common garden weed. Leaves scattered, clustered at the ends of the branches, spatulate or obovate, thick, dull green or reddish. Flowers small, 2" to 3" wide, sessile, solitary, opening only in the morning sunshine. Petals pale yellow. Stamens 7 to 12, sensitive. June to Aug.

2. *P. grandiflora*, Hook. SUN PLANT. ROSE MOSS. An ornamental annual from Brazil, with slender, prostrate or ascending stem, and large, purple or yellow flowers. Leaves scattered, short, terete, with hairy axils. Flowers 1' across, 3 or 4 together, terminal, surrounded by whorls of leaves, and crowded, woolly hairs. Many garden varieties are cultivated. Var. *Thellusonii*, Hort., has orange-scarlet, 2-lobed petals. June, July.

II. CLAYTONIA, L. SPRING BEAUTY. Low, annual or perennial, smooth, fleshy herbs, with the stem leaves usually opposite and sessile and sometimes connate. Sepals 2, ovate, persistent, free. Petals 5, hypogynous. Stamens 5, inserted on the bases of the petals. Style 3-cleft. Pod 1-celled, 3-valved, 3 to 6-seeded.

1. *C. Virginica*, L. A small, fleshy perennial, of low, moist grounds from New Eng. to Ga. and Tex. Stem simple, weak, 6' to 10' long, from a small tuber deep in the ground, with 2 opposite, linear or linear-lanceolate leaves, 3' to 5' long, halfway up. Flowers in a loose, terminal raceme, with obovate, pink petals veined with deeper-colored lines. April, May.

2. *C. Caroliniana*, Mx. A perennial, of damp woods from Me. to Minn. south to Mo. and Ohio and along the Alleghanies to N.C. Very similar to the preceding, but with fewer flowers, and leaves oblong or spatulate, 1' to 2' long, and petioled, and sometimes spatulate, radical leaves. April, May.

ORDER 16. HYPERICACEÆ — ST. JOHN'S-WORT FAMILY

Herbs or shrubs, with opposite, entire, exstipulate leaves punctate with pellucid or black dots, and regular, perfect, hypogynous, usually yellow or white flowers in terminal or axillary panicles or cymes, rarely solitary. Sepals 4 or 5, imbricate in bud, persistent. Petals 4 or 5, mostly oblique and convolute in bud, deciduous. Stamens few

or many, usually in clusters or sets. Ovary compound, with styles distinct or united. Capsule 1-celled, with 2 to 5 parietal placentæ and 2 to 5 styles; or several-celled when the placentæ reach the center. Seeds many, small, without albumen.

Key to Genera

Petals yellow, 4. Sepals 4, in unequal pairs	ASCYRUM	I
Petals yellow, 5. Sepals 5, equal	HYPERICUM	II
Petals pinkish, with glands between sets of stamens	ELODES	III

I. ASCYRUM, L. ST. PETER'S-WORT. Low, smooth, leafy shrubs, with 2-edged branches, black-dotted leaves, and yellow, mostly solitary flowers. Sepals 4, in pairs; the outer ones larger and leaf-like; the inner smaller and narrower. Petals 4, oblique, convolute in bud. Stamens many. Style 2 to 4. Pod 1-celled, 2 to 4-valved.

1. A. stans, Mx. COMMON ST. PETER'S-WORT. A small shrub, found in pine barrens and dry, sandy soils from Long Island and Pa. to Fla. Stem erect, 1° to 3° high, 2-edged or winged throughout, simple at base, with loose, shaggy bark; a few, erect branches above. Leaves oblong or oval, obtuse, 10" to 15" long, sessile, slightly clasping, erect or ascending. Outer sepals round-cordate, 4" to 6" long; inner lanceolate. *Petals obovate, a little longer than the sepals.* Styles 3 or 4, distinct. July, Aug.

2. A. Crux-Andrææ, L. ST. ANDREW'S CROSS. A low shrub, of dry, sandy soils from Nantucket, Mass., to Fla. and westward. Stems many, decumbent and creeping; branches 6' to 12' high, very leafy, winged above. Leaves oblong or obovate, obtuse, narrowed at the base, 6" to 18" long. Petals oblong-linear, as long as the outer oval or ovate sepals and arranged in the form of a St. Andrew's cross. Styles 2. July, Aug.

II. HYPÉRICUM, L. ST. JOHN'S-WORT. Herbs or shrubs, with opposite, entire, dotted leaves, mostly oblong or lanceolate, sessile or subsessile, and solitary or cymose, yellow flowers. Sepals 5. Petals 5, mostly oblique, convolute in bud. Stamens many, united at base into sets, without glands between, or few. Styles 3 to 5, distinct or united.

Plants shrubby	Nos. 1 to 3
Plants herbaceous	
Stamens many, distinct. Pod 1-celled	No. 4
Stamens many, in 8 to 5 sets. Pod 8-celled	Nos. 5, 6
Stamens few, 5 to 12. Plants and flowers very small	Nos. 7, 8

1. H. prolificum, L. SHRUBBY ST. JOHN'S-WORT. A diffusely branching, bushy shrub, 2° to 4° high, growing in sandy soils and along streams from N.J. to Minn. south to Ga. and Tenn. Branches smooth, 2-edged, leafy, ascending or erect. Leaves oblong-lanceolate, 1' to 3' long, obtuse, narrowed at the base to a short petiole, with smaller leaves in the axils.

Flowers many, bright yellow, 6'' to 9'' wide, in compound, leafy cymes. Sepals leaf-like, ovate. Petals obovate, longer than the sepals. Stamens many, distinct. Styles 3, united. Pod 3-celled, ovate, 4'' to 6'' long. July to Sept.

2. *H. densiflorum*, PURSH. A tall, erect shrub, growing in sandy soils from N.J. to Fla. and Tex. Similar to the preceding, but taller, 2° to 6°, with branches more numerous and slender and more toward the top, leaves smaller, 1' long, narrower and more crowded. Flowers also smaller and denser. July to Sept.

3. *H. aureum*, BARTRAM. A handsome, diffusely branching shrub, of rocky and shady places in Va., Tenn., Ga.—and westward. Stem 2° to 3° high. Leaves evergreen, oblong-ovate, 2' to 3' long, thick, bluish, obtuse, mucronate, sessile, with wavy edge. *Flowers solitary, sessile, very large, 18'' to 2' wide, with broad, recurved, orange, tardily deciduous petals* and shorter, leaf-like, ovate sepals. Stamens very numerous, running into the hundreds, shorter than the 3 partly united styles. Pod ovate, 1-celled. June to Aug.

4. *H. virgatum*, LAM. (*H. angulosum*, Mx.) A smooth, erect, slender herb, of low or wet grounds from N.J. to Ill. south to Fla. Stem 1° to 2° high, and with the branches sharply 4-angled. Leaves opaque, ovate-lanceolate, acute, sessile, ascending, 6'' to 1' long. Cymes terminal, compound, leafless, bracted, with the orange or copper-yellow flowers, 4'' to 6'' wide, often alternate on the branches. Styles 3, distinct, longer than the ovoid, 1-celled pod inclosed by the erect sepals. July to Sept.

5. *H. perforatum*, L. COMMON ST. JOHN'S-WORT. An Old World perennial, extensively naturalized, and a common weed in fields and pastures throughout the northern and central portions of the United States. Stem 1° to 2° high, woody at base, much branched, *with 2 opposite raised lines running lengthwise between the nodes*. Leaves oblong-elliptical, 6'' to 12'' long, with pellucid dots. Flowers many, 8'' to 12'' wide, in open, leafy, terminal cymes. Petals twice as long as the lanceolate, acute sepals, deep yellow and bordered with black dots. Stamens many, in 3 sets. Styles 3, distinct. Pod ovoid, 3-celled. June, July.

6. *H. maculatum*, WALT. SPOTTED ST. JOHN'S-WORT. A perennial, common in moist grounds from Me. to Minn. south to Fla. and Tex. Stem terete, 1° to 3° high, corymbously branched. Leaves oblong or ovate-lanceolate, sessile or nearly so, sometimes clasping, *sprinkled with many both black and pellucid dots*. Flowers small, 4'' to 7'' wide, crowded. *Petals light yellow, marked with oblong, black dots*. Stamens many, in 3 or 5 sets. Styles 3, distinct. Pod 3-celled. July to Sept.

7. *H. matitum*, L. DWARF OR SMALL-FLOWERED ST. JOHN'S-WORT. A very small annual, of damp, sandy soils from Me. to Minn. south to Fla. and Tex. Stem 3' to 9' high, with 4-angled branches. Leaves ovate-oblong, obtuse, clasping, 5-veined, minutely dotted, 4'' to 8'' long. *Flowers minute, 2'' across, orange-colored, in leafy cymes*. Petals shorter than the sepals. Stamens 6 to 12. Styles 3, distinct. Pod 1-celled. July to Sept.

8. *H. nudicaule*, WALT. (*H. sarothra*, Mx.) ORANGE GRASS. PINE-WEED. A delicate, little annual, of the same habitat and range as the preceding. Stem and branches erect, thread-like, 4-angled, 4' to 9' high. Leaves very minute, awl-shaped, appressed. Flowers minute, sessile, yellow. Stamens 5 to 10. Styles 3, distinct. Pod a slender cone, much longer than the sepals. June to Oct.

III. *ELODES*, ADANS. MARSH ST. JOHN'S-WORT. Perennial marsh herbs, with small, dense, axillary or terminal clusters of pinkish or purplish flowers. Sepals 5, equal. Petals 5,

equilateral, imbricated in bud. Stamens 9, rarely more, in 3 sets alternate with 3 hypogynous, orange-colored glands. Styles 3, distinct. Pod 3-celled.

1. *E. campanulata*, PURSH. (*ELÏDEA VIRGINICA*, NUTT.) A smooth perennial, of purplish hue, growing in swampy grounds from Me. to Neb., Fla., and La. Stem erect, nearly or entirely simple, 1° to 2° high. Leaves oblong or ovate, 12" to 30" long, closely sessile or clasping, obtuse, glaucous beneath. Flowers 6" to 8" across, pink or orange-purple, in small, close, peduncled axillary and terminal cymes. Petals twice as long as the sepals. Stamens united below the middle in 3 sets. Glands ovoid. Capsule oblong-ovoid. July to Sept.

2. *E. petiolata*, PURSH. A perennial similar to the preceding in the character of habitat, but confined to the Southern States as far north as Md. and N.J. Resembling it in general appearance and characteristics, it differs in having the leaves tapering to a petiole, or at least only sessile, not clasping, the flower clusters nearly sessile, and in the axils only, with smaller flowers, and the stamens united beyond the middle. Aug., Sept.

ORDER 17. TERNSTRÛMIACEÆ — CAMELLIA OR TEA FAMILY

Trees or shrubs, with alternate, simple, feather-veined, exstipulate leaves, and showy, regular, polyandrous, hypogynous flowers. Sepals and petals imbricated in the bud. Stamens many, united at the base into a ring, or into 1, 3, or 5 sets, opposite the petals and adhering to their bases. Anthers 2-celled, introrse. Capsule woody, 3 to 5-celled, loculicidal. Seeds few, with little or no albumen, large embryo, and broad cotyledons.

Key to Genera

Leaves evergreen. Stamens united at base in 1 set	CAMELLIA	I
Leaves evergreen. Stamens united at base in 5 sets	GORDONIA	II
Leaves deciduous	STUARTIA	*

* See some larger flora.

I. *CAMELLIA*, L. TEA ROSE. Trees or shrubs, with smooth, coriaceous, evergreen, serrate leaves, and large, terminal or axillary, mostly solitary, white or red flowers. Sepals 5 or 6, gradually passing from bracts into the 5 or 6 or more petals. Stamens many, the outer ones cohering at the base with each other and with the united bases of the petals; the inner ones free. Style 3 to 5-cleft.

1. *C. japonica*, L. COMMON CAMELLIA. JAPAN ROSE. An ornamental shrub, hardy in the southern U.S., from Japan, where it is a large tree. Leaves ovate, acuminate, 2' to 4' long, sharply serrate, on short petioles, smooth and shining on both sides. Flowers 3' to 5' across,

terminal or nearly so, usually solitary, flowering through the winter; originally of 5 to 7 obovate, red petals, but by cultivation changed to white and variegated colors, and double forms, to as many as 300 varieties. Stamens normally 50 or more, changed mostly to petals as in the rose.

II. GORDONIA, ELLIS. Trees or shrubs, with thick, ever-green leaves, and large, white, solitary flowers on axillary peduncles. Sepals 5, roundish, concave, imbricated. Petals 5, thick, obovate, imbricated. Stamens many, united in 5 sets, one set adhering to the base of each petal. Style 1. Capsule ovoid, woody, 5-celled. Seeds 2 or more in each cell.

1. G. Lasianthus, L. LOBLOLLY BAY. A large tree, of the swamps near the coast from Va. to Fla.; in ornamental cultivation a shrub 8° to 10° high. Leaves obovate-lanceolate, narrowing to the base, finely serrate, 4' to 6' long, smooth, shining, dark green above, clustered at the ends of the branches. Flowers white, about 2' across, on peduncles half the length of the leaves. Petals oblong-ovate. Sepals small, silky outside. Stamens short, on a fleshy 5-lobed cup adhering to the base of the petals. July, Aug.

ORDER 18. MALVACEÆ — MALLOW FAMILY

Innocent, mucilaginous herbs or shrubs, with tough, fibrous bark, alternate, mostly palmately veined leaves, small, deciduous stipules, and regular, perfect, rarely imperfect flowers. Sepals 5, valvate in the bud, united below, and often subtended by a calyx-like involucre. Petals 5, convolute in bud, hypogynous. Stamens many, monadelphous, attached at the base to the short claws of the petals and forming a column around the pistils. Ovaries united, becoming a several-celled pod, or a ring of 1 to several-seeded carpels, separating when ripe. Anthers kidney-shaped, 1-celled, opening along the top. Seeds usually kidney-shaped, with little if any albumen and a curved embryo.

Key to Genera

- a. Calyx with involucre bracts.
 - Bracts small, 6 to 9. Fruit indehiscent, 1-seeded carpels **ALTHEA** I
 - Bracts small, 8. Fruit indehiscent, 1-seeded carpels **MALVA** II
 - Bracts small, several. Fruit a 5-celled, 5-seeded pod **KOSTELETZKYA** *
 - Bracts small, many. Fruit a 5-celled, many-seeded pod **HIBISCUS** V
 - Bracts large, 8, leaf-like, toothed. Fruit a pod **GOSSYPIMUM** VI
- a. Calyx without involucre bracts.
 - Carpels 1-seeded. Flowers dioecious **NAPÆA** *
 - Carpels 1-seeded. Flowers perfect **SIDA** III
 - Carpels 3 to 9-seeded. Flowers perfect **ABUTILON** IV

* See some fuller flora.

I. **ALTHÆA**, L. Woolly or hairy perennials. Calyx 5-cleft, with a 6 to 9-cleft involucre. Petals 5. Stamens bearing their anthers at the top of the column. Styles many, stigmatic along the inner side. Carpels as many as the styles, 1-seeded, indehiscent, arranged circularly, separating and falling away when ripe.

1. **A. officinalis**, L. MARSH MALLOW. An Old World perennial, naturalized in the borders of the salt marshes along the coast of New Eng. and N.Y. Stem erect, branching, 2° to 4° high, covered with woolly down. Leaves velvety on both sides, ovate, lower ones sometimes cordate, dentate, often 3-lobed. Flowers pink or pale purple, 12" to 18" across, in axillary and terminal racemes. The thick root furnishes mucilage and an ingredient of the sweetmeat, marsh mallows. Aug., Sept.

2. **A. rosea**, CAV. HOLLYHOCK. An Old World, ornamental biennial or perennial, widely cultivated. Stem erect, hairy, simple, 3° to 6° high. Leaves large, rugose, round-heart-shaped, 5 to 7-lobed or -angled, dentate. Flowers large, nearly sessile, axillary, and in a long, terminal spike. Petals single or double, of all shades of pink, purple, yellow, or white. July to Sept.

II. **MÁLVA**, L. MALLOW. Old World herbs, with dentate, angled, lobed, or dissected leaves, and clustered or solitary flowers. Calyx 5-cleft; involucre bracts 3, distinct. Petals 5, obovate or truncate. In other features, the same as *Althæa*.

Flowers small. Leaves orbicular. Stem prostrate	No. 1
Flowers small. Leaves orbicular. Stem erect	No. 2
Flowers large. Leaves orbicular. Stem erect	No. 3
Flowers large. Leaves 5 to 7-parted. Stem erect	No. 4

1. **M. rotundifolia**, L. COMMON OR LOW MALLOW. A very common weed, naturalized in gardens and around dwellings everywhere from Me. to Tex. Stem prostrate, from a deep biennial or perennial root. Leaves roundish-heart-shaped, obtusely or obscurely 5-lobed, crenate, on very long petioles. Flowers axillary, clustered, 4" to 7" across; petals pale pink or whitish, notched, twice as long as the calyx lobes. Fruit flattened, disk-like, consisting of 12 to 15 carpels circularly arranged, giving occasion to the children's name of "cheeses." June to Oct.

2. **M. crispa**, L. CURLED MALLOW. A tall, simple, erect, smooth annual from Syria, cultivated for foliage and somewhat escaped from gardens in northeastern U.S. Stem 5° to 6° high, with large, rounded, angular-lobed, toothed leaves, *crisped and curled around the margin*. Flowers small, white, crowded in the axils. June to Aug.

3. **M. sylvestris**, L. HIGH MALLOW. An ornamental biennial, somewhat escaped from gardens and naturalized along roadsides in the Middle and Western States. Stem erect, branched, 2° to 4° high. Leaves acutely 5 to 7-lobed, toothed. Flowers 12" to 18" across. Petals reddish purple with darker veins. Carpels about 10, rugose. June to Oct.

4. **M. moschata**, L. An ornamental perennial of the gardens, somewhat escaped from cultivation. Stem erect, hairy, 1° to 2° high, with the radical leaves orbicular or reniform, and those of the stem 5-parted with the segments once or twice cleft into linear lobes. Flowers white or pink, 18" across, crowded on short peduncles on the tops of the stem and branches. The whole plant has a slight musky odor. July.

III. SIDA, L. Branching herbs or shrubs, with mostly undivided, serrate, crenate, or lobed leaves, and small, axillary flowers. Calyx 5-cleft, without involucrate bracts. Petals 5. Styles 5 to 12, with capitate stigmas. Ovary with as many cells as styles. Cells 1-seeded, 2-valved or 2-beaked at the top, separating from each other and from the central axis when ripe.

1. *S. spinosa*, L. A bushy annual, supposed to be of tropical origin, widely dispersed as a weed as far north as N.Y. and Iowa. Stem rigid, minutely pubescent, 10' to 20' high, with erect branches. Leaves 1' to 2' long, oblong-ovate or ovate-lanceolate, serrate, with a somewhat spine-like tubercle at the base of the longer petioles. Flowers axillary, on short peduncles, 2" to 4" wide. Petals obovate, yellow, soon falling. Fruit ovate, separating into 5 2-beaked carpels. July, Aug.

IV. ABUTILON, TOURN. Herbs or shrubs, with long-stalked, heart-shaped, angular, or lobed leaves, cells of fruit 3 to 9-seeded, and other characteristics as in *SIDA* above.

1. *A. Avicennæ*, DICKS. INDIAN MALLOW. VELVET LEAF. A stout, branched annual, 3° to 4° high, from India, naturalized in waste places in most of the area of this flora except the extreme north. Densely and finely pubescent, especially the large, velvet-like, round-heart-shaped, acuminate leaves, 4' to 12' in diameter. Flowers 6" to 9" across, yellow or orange, solitary axillary on stout peduncles shorter than the petioles. Fruit about 1' wide, consisting of 12 to 15 3-seeded carpels, each dehiscent at the top, with 2 awned beaks. July to Oct.

2. *A. striatum*, DICKS. STRIPED ABUTILON. A smooth, ornamental, greenhouse shrub from Brazil, with large, thin, long-stalked, 3 to 5-lobed, maple-like leaves. Flowers large, bell-shaped with contracted mouth, orange-yellow, red or purple-veined, and drooping on long, curving peduncles. A continuous bloomer.

V. HIBISCUS, L. Herbs, shrubs, or trees, with petioled, palmately parted, or veined leaves, and usually large, showy, mostly bell-shaped flowers. Calyx 5-cleft or 5-toothed, with many linear, subtending bracts. Stamens many, with their anthers along much of the length of the 5-toothed or truncate column. Pistils united below, with 5 distinct, capitate or peltate stigmas. Fruit a 5-celled, 5-valved, loculicidal, many-seeded pod.

Native; tall, perennial herbs	. . . . .	Nos. 1, 2
Exotic; cultivated or escaped; a tall shrub	. . . . .	No. 8
Exotic; cultivated or escaped; annual herbs	. . . . .	Nos. 4, 5

1. *H. Moscheutos*, L. SWAMP ROSE MALLOW. MARSH HIBISCUS. A tall perennial, of brackish marshes along the coast from Mass. to Fla. and La.; also near the Great Lakes, and in the interior near salt springs. Stem round, downy, simple, erect, 4° to 8° high. Leaves ovate or ovate-lanceolate, 3' to 7' long, dentate, palmately veined; lower ones, some-

times all, with 2 lateral lobes; all with white, soft down beneath, nearly smooth above. Flowers 4' to 7' wide, rose-colored, with a purple or crimson center, on peduncles sometimes united at the foot with the petioles. *Fruiting calyx not inflated. Seeds smooth.* Aug., Sept.

2. *H. militaris*, Cav. HALBERD-LEAVED ROSE MALLOW. A tall, smooth perennial, of river banks from Pa. to Minn. south to Fla. and La. Stem 3° to 4° high. Leaves thin, 3' to 5' long, on long, slender petioles, ovate or ovate-lanceolate, with cordate or truncate base, and dentate or serrate margin; some, or sometimes all, *hastately 3-lobed*. Flowers 2' to 3' long, pale rose-colored, with purple center, axillary or in terminal clusters. *Calyx in fruit inflated. Seeds silky.* Aug., Sept.

3. *H. Syriacus*, L. TREE HIBISCUS. SHRUBBY ALTHÆA. ROSE OF SHARON. An ornamental, tree-like shrub from Syria, sparingly escaped from cultivation in southern N.J. and southward. Nearly smooth, branching, 10° to 20° high. Leaves wedge-ovate, 2' to 5' long, short-petioled, strongly 3-ribbed, sometimes 3-lobed, dentate. Flowers short-peduncled, solitary, axillary, somewhat bell-shaped, 2' to 4' across, rose or purple, with a dark base. Varieties in cultivation have white, red, and striped, single and double flowers. Capsule ovoid, about 1' long, splitting into 5 valves. Very abundant on the Plain of Sharon in Syria. Aug., Sept.

4. *H. Tridnum*, L. BLADDER KETMIA. FLOWER OF AN HOUR. A low, hairy annual from southern Europe, escaped from gardens and somewhat naturalized from New Eng. to Fla. and here and there in the interior. Leaves deeply 3-parted, with lanceolate segments, the middle one longest, all more or less lobed or toothed. *Calyx in fruit inflated, membranous, 5-angled, veined, hispid.* Involucrate bracts subulate, entire. Flowers many, yellow, with purple centre, 1' to 2' wide, axillary to the upper leaves, withering in a few hours. Aug., Sept.

5. *H. esculentus*, L. OKRA OR GUMBO. A half-hardy, East Indian annual, cultivated for its pods used in cookery. Stem terete, erect, 2° to 5° high. Leaves rounded, heart-shaped, 8' to 10' wide, with 3 to 5 oblong, toothed lobes and bristly petioles 6' long. Flowers 1' to 2' long, solitary, axillary, greenish-yellow, with a crimson center, on peduncles 1' long. Involucrate bracts about 5, caducous. *Calyx split down one side, falling off early.* Pod ribbed or angled, long-pyramidal, 3' to 5' long.

VI. GOSSÝPIUM, L. COTTON. Herbs or shrubs, with usually palmately lobed leaves and yellow or purple flowers. Calyx cup-shaped, obtusely 5-toothed, subtended by 3 large, leaf-like bracts. Stamens very many, with the anthers along the column. Styles united. Stigmas 3. Capsule 3 to 5-celled, few or many-seeded. Seeds woolly. The species are very much confused.

1. *G. herbaceum*, L. COMMON COTTON. An annual of disputed nativity, but probably Asiatic, cultivated as the chief staple of the Southern States. Stem 3° to 5° high. Leaves with 3 to 5 *short, roundish lobes*; upper ones often with only 2 or 3; *with but one gland beneath*. Flowers 3' wide, light yellow, with a purple center. *Seeds brownish.* Sown in the spring, harvested in autumn.

2. *G. Barbádense*, L. SEA ISLAND COTTON. A West Indian annual or biennial (?), somewhat shrubby at base, cultivated mainly along the coast. *Glands on the midvein 3. Leaves with the lobes lance-ovate and taper-pointed. Seeds black.* Cotton long and silky. Sown in Sept. and Oct.

ORDER 19. TILIACEÆ — LINDEN FAMILY

Trees or shrubs, rarely herbs, with simple, mostly alternate leaves, usually small, deciduous stipules, and axillary or terminal, regular, hypogynous, polyandrous flowers. Sepals 5, rarely 3 or 4, deciduous, valvate in the bud. Petals as many or fewer, or none; usually imbricated in the bud. Stamens mostly polyadelphous. Anthers 2-celled, versatile. Ovary free, sessile, compound, of 2 to 10 cells. Fruit dry or fleshy, 2 to 10-celled, or by abortion 1-celled. In its mucilaginous properties and fibrous bark, the order resembles the preceding one.

I. TÍLIA, L. LINDEN OR LIME TREE. BASSWOOD. Trees, with heart-shaped, serrate, oblique leaves, and white or cream-colored flowers in axillary or terminal cymes on peduncles attached for half their length to the midvein of a large, leaf-like, ligulate bract. Sepals 5, colored. Petals 5, oblong-spatulate, alternate with the sepals, sometimes with a petaloid scale at the base of each. Stamens many, free or polyadelphous. Ovary 5-celled, with 2 ovules in each cell. Fruit globose, nut-like, indehiscent, becoming 1-celled, 1 to 2-seeded. Albumen hard. Embryo with broad, thin, 5-lobed, wrinkled cotyledons.

Petals with petaloid scales Nos. 1, 2, 3
 Petals without petaloid scales No. 4

1. T. Americana, L. BASSWOOD. AMERICAN LINDEN. WHITEWOOD. A large tree, with thick, dark gray, furrowed bark, 50° to 75° high, and 2° to 4° in the diameter of its trunk, growing in rich woods and lowlands from Me. to Ga. and westward. Leaves obliquely broad-heart-shaped, acuminate, 5' to 6' long by 3' to 4' wide, thick, with sharp, irregular teeth, smooth, dark green, shining above, and smooth but paler, with tufts of brown hairs in the axils of the veins beneath. *Peduncular bract* linear-oblong, yellowish, usually with tapering base. *Stamens clustered with the petaloid scales*, which are nearly as long as the petals. Fruit gray, downy, ovate, the size of small peas. Wood white, soft, free from knots, much used in cabinet work. May, June.

2. T. pubescens, AIT. DOWNY LINDEN. SMALL-LEAVED BASSWOOD. A smaller tree than No. 1, with a more southerly range, — from L.I southward and westward, — *thinner and smaller leaves*, 2' to 3' long, a *rusty down on twigs, leaves, and fruit*, and the peduncular bracts more rounded at the base. Its average height is 40° to 50°, with a trunk 1° in diameter. *Leaves* smooth above, but *pubescent or even densely woolly beneath*.

3. T. heterophylla, VENT. WHITE BASSWOOD. A forest tree, found in the Alleghanies and Blue Ridge from southern Pa. to Fla. and west to Ill. and Ala. It is somewhat smaller than No. 1, but differs mainly in

BRIEF FLORA — 5

having larger and more oblique leaves, silvery white and velvety beneath, with purple ribs and narrower petaloid scales.

4. *T. Europæa*, L. LIME TREE. EUROPEAN LINDEN. An ornamental, European tree, with denser foliage, smaller, more rounded, more numerous leaves, and on shorter petioles than No. 1 above, but easily and clearly distinguishable from any of the above American species by the absence of the petaloid scales in the flowers. Various forms of this and other European species are also cultivated for ornament.

ORDER 20. LINACEÆ—FLAX FAMILY

Herbs, rarely shrubs, with alternate or opposite leaves, and regular, perfect, hypogynous, nearly symmetrical flowers. Sepals 4 to 5, imbricated, persistent. Petals 4 to 5, convolute, alternate with the sepals. Stamens 4 to 5, united at the base. Ovary 1, compound, with as many cells as styles, or twice as many by a false partition. Fruit generally a globose capsule, splitting into 5 2-seeded carpels, each more or less 2-celled.

I. *LINUM*, L. FLAX. Herbs, with a bark of tough fibers, alternate or opposite, simple, entire, narrow, sessile, exstipulate leaves, often with glands for stipules, and nearly symmetrical flowers. Sepals, petals, stamens, and styles 5. Capsule as in the description of the family. Seeds flattened, mucilaginous, with little or no albumen, and a large, oily embryo.

Flowers blue	No. 1, 2, 3
Flowers yellow	Nos. 4, 5
Flowers red or crimson	No. 6

1. *L. usitatissimum*, L. COMMON FLAX. A cultivated annual, somewhat escaped and naturalized by roadsides and in waste places. Stem erect, 1° to 2° high, slender, terete, striate, smooth, somewhat glaucous, branching above. Leaves alternate, 3-veined, linear-lanceolate, 5" to 18" long. Flowers rich blue, 6" to 8" across, in a corymbose, leafy panicle. Petals wedge-shaped, crenulate, twice as long as the ovate, acuminate sepals. Native country unknown. Cultivated from the remotest antiquity (see Gen. xli. 42) for the fiber of its bark. The seeds are the source of linseed oil, and are used medicinally. June, July.

2. *L. perenne*, L. PERENNIAL FLAX. A smooth, Old World, ornamental perennial, with scattered, linear leaves and pale blue flowers on slender pedicels, and with emarginate petals. Pink and white varieties also occur. Petals 3 or 4 times as long as the sepals. Flowers dimorphic. June, July.

3. *L. Lewisii*, PURSH. LEWIS'S WILD FLAX. A perennial, of the prairies from Minn. to Tex. and westward, with stem 1° to 2° high, and blue flowers 12" to 18" across. Differs from No. 2 mainly in its flowers not being dimorphous. In other respects so much like it as to have been regarded by some as a mere variety, *L. PERENNE*, Var. *Lewisii*, EAT. AND WRIGHT.

4. *L. Virginiānum*, L. An annual, or by its suckers a perennial, herb, common in dry woods and shady places from New Eng. to Ga. Stem smooth, slender, terete, upright, 1° to 2° high, simple below, corymbously branching above. Leaves oblong-lanceolate or oblanceolate, 6" to 8" long, the lower often opposite and spatulate. Flowers *yellow*, 3" to 5" across. July, Aug.

5. *L. striātum*, WALT. (*L. DIFFUSUM*, WOOD.) A perennial, of wet and boggy grounds from Mass. to Ill. and southward. *Stems* in groups, erect or ascending, somewhat viscid and *with their short, racemose branches striated with about 4 sharp angles or wings decurrent from the bases of the leaves*. Stem leaves larger and broader than in No. 4; branch leaves very small. Flowers *yellow*, very small. July.

6. *L. grandiflorum*, DESF. RED OR CRIMSON FLAX. An ornamental perennial from North Africa, cultivated as a hardy annual, with a smooth, erect stem, branching above, about 1° high, and elliptic-lanceolate or linear-lanceolate leaves. Flowers *bright crimson*, 1' in diameter, with broadly obovate petals and ciliate-serrulate sepals and bracts. July.

ORDER 21. GERANIACEÆ — GERANIUM FAMILY

Herbs or shrubby plants, with swollen joints, alternate or opposite, palmately veined, stipulate leaves and perfect, symmetrical, hypogynous flowers. Sepals and petals 5, the former imbricated in the bud and persistent. Stamens usually 10, monadelphous at base, the 5 exterior ones shorter and often abortive. Ovary deeply 5-lobed, consisting of 5 long-styled carpels, each 2-ovuled, but 1-seeded in fruit, when they separate elastically from the elongated receptacle on their persistent styles curving upward. Seeds without albumen.

Key to Genera

Corolla regular. Perfect stamens 10	GERANIUM	I
Corolla regular. Perfect stamens 5	ERODIUM	*
Corolla irregular. Perfect stamens usually 7	PELARGONIUM	II

* See some fuller flora.

I. *GERANIUM*, L. CRANE'S-BILL. Mostly herbs, with fork-ing stems, stipulate, palmately, rarely pinnately, divided, cleft, lobed or dissected leaves, and regular, 5-merous flowers. Stamens 10, perfect, each of the 5 inner and longer ones with a gland at the base. Fruit long-beaked, like a *crane's bill*, whence the vernacular as well as the botanical name, the Greek "*geranos*" signifying a crane. *Erodium*, *heron's bill*, and *Pelargonium*, *stork's bill*, are so named for the same reason. Styles smooth inside and adhering to the upper part of the recep-

taele after curving upward from its base. Peduncles 1 to 3-flowered.

Flowers large, 1' across. Perennial	No. 1
Flowers small, 2' to 6" across. Annual or biennial. Leaves ternately divided	No. 2
Flowers small, 2' to 6" across. Annual. Leaves palmately lobed	No. 3

1. *G. maculatum*, L. WILD OR SPOTTED GERANIUM OR CRANE'S-BILL. A handsome perennial, of open woods and fields from New Eng. to Ga., Ala., and Mo. Stem from a thick rootstock, erect, 1° to 2° high, dichotomous, hairy. Leaves 3' to 6' wide, palmately 3-lobed, with wedge-shaped segments which are entire at base but lobed and cut at the top. Radical leaves with long petioles; stem ones with much shorter ones and opposite. Flowers pink-purple, 12" to 18" across. Petals entire. Sepals awn-pointed. The specific name refers to the whitish spots or blotches on the older leaves. Rootstock very astringent. April to July.

2. *G. Robertianum*, L. HERB ROBERT. RED ROBIN. A strong-scented annual or biennial, of rocky places from New Eng. to Va., Ky., and Mo. Stem reddish, somewhat hairy, diffuse, weak, erect or decumbent, 6' to 18' high. Leaves 3-divided or 5-divided to the base, the segments twice pinnatifid. Flowers red-purple, about 6" across. Petals entire, twice as long as the awned sepals. Capsules wrinkled, keeled. A plant common also to the Old World, where it is known as "Herb Robert" from its supposed medicinal use by Robert, Duke of Normandy, and as "Red Shanks" among the Scotch Highlanders, from its red stems. May to Oct.

3. *G. Carolinianum*, L. A stout annual, common in barren soils from New Eng. to Fla. and Tex. Stem diffusely branching from the base as well as above, 8' to 15' high. Leaves deeply 5-parted, the segments cleft and cut into oblong, toothed lobes. Flowers pale pink, 4" to 6" across, in close clusters on short pedicels and peduncles. Petals notched, no longer than the ciliate, awn-pointed sepals. Carpels hairy. Seeds reddish-brown, minutely reticulated, ovoid-oblong. April to Aug.

II. *PELARGONIUM*, L'HER. Ornamental, perennial herbs or shrubby plants, mostly from South Africa, known popularly as "geraniums" according to their original classification by Linnæus in 1753. L'Heritier founded this genus for them in 1787. Leaves opposite, rarely alternate, stipulate, entire, toothed, lobed, or variously cleft or divided. Flowers irregular, usually in umbels or axillary peduncles. Sepals 5, imbricate in the bud, united at the base, the upper segment having a spur adnate to the pedicel. Petals 5, the two upper ones differing more or less from the others in form or size. Stamens 10; 7 with anthers; 3 without. Pistils, fruit, etc., as in *Geranium*.

From nearly or quite 200 original species, cultivation has produced such a host of varieties that the determination of the relations, or species of any particular specimen is often difficult and sometimes impossible. The few species, accordingly, that are given below are only approximately accurate.

a. Stems trailing or climbing	No. 1
a. Stems erect, shrubby, very short	No. 4
a. Stems erect, shrubby, 2° to 3° high. (b)	
b. Leaves round-cordate, crenate, not deeply lobed or cleft	Nos. 2, 3
b. Leaves deeply lobed or pinnatifid	Nos. 5, 6

1. **P. peltatum**, AIT. IVY-LEAFED GERANIUM. A trailing or climbing plant, with weak, straggling, angular branches. Leaves fleshy, generally smooth, peltate, with 5 angular lobes, the margins entire. Flowers pink, varying to white, large or small, with the 2 upper petals erect and blotched or striped, the 3 lower smaller and separated from the upper ones in a 2-lipped fashion, in 4 to 8-pediceled umbels, on elongated peduncles. July.

2. **P. zonale**, WILLD. HORSESHOE GERANIUM. One of the most common species, with a thick, erect, shrubby stem, 2° to 3° high, and roundish, cordate, toothed, long-petioled leaves, *normally and usually marked with a dark horseshoe-shaped zone*. Flowers bright scarlet, nearly sessile, in umbels on long peduncles, the color varying, however, from cultivation through all shades to pure white, the zone also sometimes disappearing. Calyx tube 4 or 5 times as long as the segments. Petals narrow, wedge-shaped or spatulate. Aug. One of the most marked varieties is **Var. marginale**, which has the leaves bordered with white.

3. **P. inquinans**, AIT. SCARLET GERANIUM. A shrubby species, about 2° high, with round-kidney-shaped, crenate, *viscidly pubescent leaves on short petioles*. Flowers many, on short pedicels, umbeled, on long peduncles. Petals broadly obovate, normally intense scarlet, but by cultivation varying through all shades to white. The parent of most of the so-called "scarlet geraniums." The specific name, *inquinans*, refers to the staining effect on the fingers in handling the soft, clammy branches.

4. **P. odoratissimum**, AIT. (*P. fragrans*, SWEET.) NUTMEG-SCENTED G. *Stem very short and shrubby, with long, diffuse, slender, herbaceous branches*. Cultivated mainly for the strong fragrance of the foliage. Leaves small, long-petioled, densely pubescent and velvety, round-cordate, generally 3-lobed, bluntly toothed or crenate, strongly veined beneath. Flowers very small, on short pedicels, with white petals, the two upper marked with red lines. Summer.

5. **P. quercifolium**, AIT. OAK-LEAVED G. A common shrubby greenhouse plant, about 3° high, with a much-branched, rather hairy and glandular stem, and long-petioled, *pinnately lobed*, often spotted leaves. Leaf lobes 2 to 3 pairs, with a terminal one, oblong and again toothed or crenate. Flowers red or purplish, rather small, 3 to 5, on short, umbeled pedicels.

6. **P. graveolens**, AIT. HEAVY-SCENTED OR ROSE-SCENTED G. Similar to No. 5, but with the *leaves palmately 5 to 7-lobed, the lobes oblong and bluntly toothed*, and the small, pink, or light purple flowers numerous and nearly sessile in heads on generally long peduncles. Leaves very fragrant.

ORDER 22. OXALIDACEÆ. — WOOD SORREL FAMILY

Leafy-stemmed or stemless herbs, with acid juice, alternate or radical, compound leaves, and regular, hypogynous, 5-merous flowers. Sepals imbricated; petals convolute in bud; the former persistent. Stamens 10, often monadelphous at base. Styles 5, distinct or united. Ovary and capsule 5-celled; each cell 2 to several-seeded. Embryo straight, in fleshy albumen.

I. **OXALIS**, L. WOOD SORREL. Annual or perennial herbs, with trifoliate leaves and obcordate leaflets, drooping and

closing in the evening. Sepals distinct or united. Petals much longer than the sepals, sometimes cohering at base, and soon withering. Stamens 10, perfect, united at base, alternate ones shorter. Styles 5, distinct, sometimes persistent. Stigmas capitate. Capsule 5-lobed; the 5 cells opening loculicidally, the valves remaining attached to the axis. Seeds 2 or more in each cell. Several species produce also cleistogamous flowers, and the ordinary flowers are often dimorphous or trimorphous.

Stemless species. Flowers solitary, on a scape	No. 1
Stemless species. Flowers umbelled, on a scape	No. 2
Leafy-stemmed species. Flowers on axillary peduncles and yellow	No. 3

1. *O. Acetosella*, L. COMMON WOOD SORREL. SHAMROCK. A stemless perennial, of cold, damp woods from New Eng. to Pa. and southward in the mts. Leaves from a creeping rootstock, on petioles 3' to 6' long, with broadly obcordate leaflets, purplish beneath. Flowers solitary, on scapes 2' to 5' high. Petals white or pinkish with reddish veins. Produces cleistogamous flowers. June, July.

Obs. — A native also of Ireland and of the Old World generally, this plant is probably the most rightful claimant of several to being the real "shamrock." See bottom of page 108.

2. *O. violacea*, L. VIOLET W. S. A stemless perennial, of open and rocky woods from New Eng. to Fla. and west to the Rockies. Leaves similar to those of No. 1, but arising from a scaly bulb, from which also arises the flower scape, the latter bearing at its summit several violet-petaled flowers in an umbel. May, June.

3. *O. stricta*, L. UPRIGHT YELLOW W. S. The most common of all our wood sorrels, found everywhere, in woods, fields, and gardens, from Me. to Tex. An annual or perennial. Stem erect, 3' to 12' high, leafy, terete, smooth, with axillary, 2 to 3-flowered peduncles longer than the petioles. Flowers yellow, in cymose umbels, varying like the plant very much in size. Petals usually reddish at base. Pods erect, columnar, narrowing abruptly at the top.

Obs. — This species, from its wide range and varied habitat, necessarily varies very much, and is liable to be confounded with several other native species and with one introduced, cosmopolitan one, all omitted here for want of space. For these see Dr. Britton's Manual or Britton and Brown's Flora.

ORDER 23. BALSAMINACEÆ — JEWELWEED FAMILY

Tender, succulent herbs, with watery juice, alternate, simple, exstipulate leaves, and very irregular, unsymmetrical flowers. Sepals colored, scarcely distinguishable from the petals; the 2 sets consisting of 6 hypogynous segments, the 2 outer ones small and oblique, clearly sepals, as probably also the next, a large spurred hood. Opposite this last is what may be regarded as a notched

petal, and within and at right angles to this 2 unequally lobed petals. Stamens 5, hypogynous, with connivent scales on the inner side of the short filaments. Stigma sessile, 5-lobed. Capsule oblong, 5-celled, bursting elastically, on being touched, into 5 spirally coiling valves, and scattering the seeds. Seeds several in each cell. Embryo straight, without albumen. Cleistogamous flowers are often produced.

I. IMPATIENS, L. JEWELWEED. TOUCH-ME-NOT. Erect, branching herbs, with smooth, pellucid stems and swollen joints. With the exception of a solitary Asiatic species, the only genus of the family and, accordingly, already described above.

1. I. fúlva, NUTT. TAWNY OR SPOTTED JEWELWEED. A smooth annual, 2° to 4° high, common in wet, shady places from Me. to Dak. and south to Fla. and Mo. Leaves thin, elliptic-ovate, coarsely toothed, 1' to 3' long, on slender petioles. Peduncles axillary, 2 to 4-flowered, with drooping, bracted pedicels. Flowers deep orange, mottled with brown spots; the horizontal hood, 9" to 12" long, ending in a closely reflexed, slender spur half its length. Nearly white and spotless forms sometimes occur. July to Oct.

2. I. pállida, NUTT. PALE JEWELWEED OR TOUCH-ME-NOT. A similar species to the preceding in appearance, habitat, and range, but with larger leaves and flowers, and the *latter pale yellow, sparingly dotted, and the recurved spur less than a third the length of the dilated, obtuse hood.* Leaves 2' to 4' long. July to Oct.

3. I. Balsámina, L. GARDEN BALSAM. An ornamental annual from India, with erect, branched stem, 1° to 2° high, crowded, lanceolate, serrate leaves, the upper alternate, the lower opposite, and clustered, short-stalked, short-spurred flowers in the axils. Colors mostly red and white, but varying greatly in cultivation. Flowers often double. Summer.

ORDER 24. TROPÆOLACEÆ — INDIAN-CRESS FAMILY

Smooth, mostly climbing, twining, or trailing herbs from South America, with alternate, peltate, or palmate leaves, showy, irregular, unsymmetrical flowers, and a watery juice, with the pungency and properties of the Mustard family. Calyx 5-cleft, colored, projecting behind in a long, hollow spur. Petals 5, sometimes fewer, the lower with claws, the 2 upper without claws and inserted at the opening of the spur. Stamens 6 to 10, separate, unequal, perigynous. Ovary of 3 carpels. Style 1. Stig-

mas 3. Fruit separating into 3 fleshy, closed, 1-seeded nuts. Seeds large, without albumen.

I. TROPÆOLUM, L. INDIAN CRESS. Characteristic features substantially those of the order.

1. T. majus, L. NASTURTIUM. A smooth annual from Peru, climbing by its long petioles, or sometimes low and not climbing, cultivated for ornament and for its young pods and seeds, which are pickled as a substitute for capers, and in England sometimes also for its pungent leaves, used in salads like cress. Leaves roundish, obscurely lobed, 2' to 3' in diameter, peltate, with the long petiole inserted near the center. Flowers large, showy, orange-colored, with deeper-colored blotches, varying to all shades of yellow and red. Spur straight, slender. Petals entire or undulate; the 2 upper remote from the 3 lower, which have fringed claws. Double-flowered forms occur. June to Oct.

ORDER 25. RUTACEÆ—RUE FAMILY

Shrubs or trees, or rarely herbs, with exstipulate leaves dotted with pellucid glands containing a volatile, aromatic or acrid oil, and regular, perfect or polygamous, hypogynous, 3 to 5-merous flowers. Stamens as many or twice as many as the sepals, or rarely more numerous, as in the orange and lemon. Pistils 2 to 5, distinct or combined into a compound ovary, sometimes raised on a glandular disk. Fruit a capsule or berry, rarely a drupe.

I. RUTA, L. RUE. Perennial, strong-smelling, Old World herbs, often woody at base, with alternate, simple or compound, gland-dotted leaves, and perfect, yellow or greenish flowers in terminal corymbs or panicles. Calyx short, 4 to 5-lobed or -parted, persistent. Petals 4 to 5, distinct, imbricate. Stamens 8 to 10. Capsule globular, 4 to 5-lobed, 4 to 5-celled, many-seeded.

1. R. graveolens, L. COMMON RUE. HERB OF GRACE. A bushy herb from southern Europe, 2° to 3° high, with woody base, 2 to 3-pinnately compound, bluish-green, strongly dotted leaves, and greenish-yellow flowers in terminal corymbs. Leaflets small, 6" to 10" long, oblong or obovate, the terminal one obovate-cuneate and notched at the end. Flowers 6" in diameter; the earliest one opening with the parts in 5's, the rest in 4's. Petals entire or slightly toothed. June to Sept.

II. XANTHÓXYLUM, L. Trees or shrubs, with alternate, unequally pinnate leaves, prickly twigs and petioles, and polygamous, whitish or greenish, mostly small flowers in axil-

lary or terminal cymes. Sepals 4 or 5, or wanting. Petals 4 or 5. Stamens in sterile flowers as many as the petals; in fertile flowers, rudimentary. Pistils 2 to 5, with slightly cohering styles and separate ovaries becoming in fruit 2-valved pods, with 1 to 2 smooth, shining, black seeds.

1. *X. Americànum*, MILL. PRICKLY ASH. TOOTHACHE TREE. A shrub or small tree, 10° to 20° high, found in rocky woods and thickets from New Eng. to Va. west to Neb. and Mo. Branches armed with strong, brown, conical prickles. Leaflets 5 to 11, ovate, 18'' to 2' long, crenulate or entire, sessile or nearly so, *equal at base*, downy when young, smooth or nearly so when old. *Flowers* very small, greenish, *in sessile, axillary cymes, appearing before the leaves*. Sepals wanting. Petals 4 or 5. Capsules ellipsoid, black, about 2'' long, *on short stipes*, 1 to 2-seeded. The bitter, aromatic, and stimulating bark is used for alleviating toothache. April, May.

2. *X. Clàva-Hérculis*, L. (*X. CAROLINIÀNUM*, LAM.) SOUTHERN PRICKLY ASH. A small and very prickly tree, of the southern U.S., 20° to 40° high, 8' to 10' in diameter, found along streams and sandy coasts from southern Va. to Fla. west to Tex. and Ark. Bark light gray, with sharp prickles projecting from large, corky cones. Leaflets 5 to 17, nearly sessile, ovate-lanceolate, *very unequal at base* except the terminal odd one, crenulate, smooth and shining, 2' to 3' long. *Flowers* many, whitish, *in large, terminal cymes, appearing after the leaves*. Sepals and petals 4 to 5. *Pods sessile*. June.

III. *PTÈLEA*, L. Unarmed shrubs or small trees, with bitter bark and alternate, 3 to 5-foliolate leaves, and small, greenish-white, polygamous flowers in terminal cymes. Calyx short, 4 to 5-parted, imbricated. Petals 4 to 5, imbricated, much longer than the calyx. Stamens in the sterile flowers alternate with the petals and longer; in the fertile, very short and imperfect. Ovary of 2 carpels united. Stigmas 2. Fruit a 2-celled, 2-seeded samara with a broad wing all around it.

1. *P. trifoliàta*, L. SHRUBBY TREFOIL. HOP TREE. A shrub or small, round-headed tree, from 6° to 20° high, found in woods and rocky places from L. I. to Minn. south to Fla. and Tex. Leaves long-petioled, trifoliolate, with ovate, pointed, sessile leaflets 2' to 4' long, downy when young. Flowers ill-scented, about 6'' across, in terminal, compound cymes. Samara 8'' to 9'' in diameter, with a membranous, netted-veined, emarginate wing. Often cultivated for ornament. Its bitter fruit is used as a substitute for hops. June.

ORDER 26. SIMARUBÀCÆ — QUASSIA FAMILY

Trees or shrubs, nearly allied to the *Rutaceæ*, but without dotted leaves. Represented in the United States by only one species.

I. AILÁNTHUS, DESF. Large, Asiatic or Australian trees, with alternate, odd-pinnate leaves, and terminal panicles of small, greenish-white, diœcious or polygamous flowers. Calyx small, 5-cleft, lobes imbricated. Petals 5, valvate, spreading. Stamens 10 in the sterile flowers; 2 or 3, or none, in the fertile. Pistils 2 to 5, with united, soon separating, lateral styles, becoming in fruit linear-oblong, membranous, veiny samaras, each with 1 seed in the center.

1. A. glandulosa, DESF. CHINESE SUMAC. TREE OF HEAVEN. A well-known tree from China, somewhat naturalized, cultivated extensively in towns and cities on account of its rapid growth. Trunk straight, 40° to 80° high. Bark smooth, brown. Leaves smooth, 1° to 3° long, with long petioles, 21 to 41, short-stalked, ovate-lanceolate, acuminate leaflets, each with 1 or 2, obtuse, *glandular* teeth at each side of the base. The clusters of samaras are a striking feature of the pistillate trees in autumn; while the ill-scented staminate flowers are very disagreeable in the early summer. May, June.

ORDER 27. MELIACEÆ—BEAD-TREE OR MAHOGANY FAMILY

Trees or shrubs, with alternate, exstipulate, usually pinnately compound leaves, and regular, terminal or axillary, paniced, diœcious, or rarely polygamo-diœcious flowers. Calyx and petals 3 to 5-merous. Stamens 6 to 10, united into a long tube, with the anthers sessile. Style 1. Ovary several-celled. Fruit dry or fleshy.

I. MELIA, L. BEAD TREE. Asiatic and Australian trees, with pinnately compound leaves, and white or purplish flowers in large, axillary, profuse panicles. Calyx 5 or 6-parted. Petals 5 or 6, linear-spatulate, spreading. Stamen tube with a 10 to 12-cleft summit and 10 to 12 anthers in the throat. Ovary 5-celled, with 2 ovules in each cell, becoming a small, globose drupe with a 5-celled, 5-seeded stone or nut. These nuts, having a natural perforation through the center, have been used for beads, and hence the name "bead tree" given to all the species.

1. M. Azédarach, L. PRIDE OF INDIA. CHINA TREE. INDIAN LILAC. A tree of tropical Asia, 30° to 40° high, widely dispersed by introduction, hardy and naturalized in the southern U.S. Leaves smooth, deciduous, bipinnate, with ovate or lance-ovate, serrate, acuminate leaflets. Flowers fragrant, lilac-colored. Drupes yellowish, the size of cherries, with a narcotic pulp, remaining on the trees through the winter. April.

ORDER 28. ILICACEÆ— HOLLY FAMILY

Shrubs or trees, with simple, petiolate, mostly alternate, generally coriaceous leaves, and small, regular, 4 to 8-merous, white or greenish, axillary, polygamous or dioecious flowers. Stipules small, and falling early, or none. Calyx free, small, usually persistent. Petals distinct or slightly united, hypogynous, imbricate, deciduous. Stamens alternate with the petals, and attached to the short tube at their base. Ovary 1, free, 4 to 8-celled, becoming a berry-like drupe, with 4 to 8 1-seeded nutlets. Embryo straight, in fleshy albumen.

I. ILEX, L. Shrubs or trees, with evergreen or deciduous, alternate, entire, dentate or spiny leaves, small, white or whitish, axillary, solitary or clustered, perfect or polygamous flowers, and red, black, or sometimes yellow, berry-like fruit, often remaining on the branches through the winter. Fertile flowers usually solitary; the sterile or partly sterile in clusters. Calyx 4 to 6-toothed. Petals 4 to 6, slightly united at base. Stamens 4 to 6. Drupe small, globose, with 4 to 6 nutlets.

Berries red.

Leaves evergreen. True hollies.

Trees, with leaves spiny-toothed Nos. 1, 2

Shrubs or trees, with leaves not spiny-toothed Nos. 3, 4

Leaves deciduous. Nutlets striate No. 5

Leaves deciduous. Nutlets smooth Nos. 6, 7

Berries black. Leaves evergreen No. 8

1. I. opaca, Ait. AMERICAN HOLLY. A small tree, 20° to 40° high, usually with a conical head, found in moist woods from southern Me. to N.J., near the coast, thence south and west to Fla., Tex., and southern Mo. Bark light gray, smooth. Leaves 2' to 3' long, wavy-margined, spiny-toothed, sometimes entire, thick, rigid, evergreen, smooth, dark, shiny green above, yellowish-green beneath. Flowers with the parts usually in 4's, the staminate in clusters, the fertile usually solitary. Drupe red, 4'' to 5'' in diameter. Nutlets ribbed. June.

2. I. Aquifolium, L. EUROPEAN HOLLY. An Old World tree, 10° to 40° high, sometimes cultivated in the U.S., but not hardy N. It differs from No. 1 mainly in having its leaves ovate and wavy and more glossy and spiny, with berries of a duller red. The species is very variable, and many varieties are in ornamental cultivation. June.

3. I. Dahoon, Walt. DAHOON HOLLY. A shrub or small tree, 5° to 20° high, found in low woods and swamps near the coast from southern Va. to Fla. and La. Young branches pubescent. Leaves oblong-obovate or oblong-lanceolate, more or less pointed at apex and base, entire or nearly so, coriaceous, smooth, shining, evergreen, dark green above, usually

downy beneath, 2' to 4' long, on petioles 2'' to 4'' long. Drupes red, 2'' to 3'' in diameter. Nutlets ribbed. May.

4. *I. Cassina*, CASSENSA. YAUPON. A bushy shrub, 6° to 15° high, found along the coast from Va. to Fla. and Tex. Leaves smooth, shining, evergreen, oval or ovate-oblong, obtuse, crenate, 6'' to 18'' long. Drupes scarlet, globose, 2'' to 3'' in diameter. Nutlets ribbed. The leaves are used for Cassena or Yaupon tea, the celebrated "black drink" of the North Carolina Indians. May.

5. *I. decidua*, WALT. SWAMP OR MEADOW HOLLY. A shrub or small tree, 6° to 20° high, of swamps and low, wet grounds from Va. to Kan. south to Fla. and Tex. Leaves deciduous, wedge-oblong or obovate, 1' to 3' long, obtusely serrate, tapering to a short petiole. Drupes red, globose, 2'' to 3'' in diameter. Nutlets ribbed. May.

6. *I. verticillata*, GRAY. COMMON OR VIRGINIA WINTERBERRY. BLACK ALDER. A shrub, 6° to 10° high, common in moist woods and swamps, from Me. to Fla. west to Wis. and Mo. Leaves deciduous, oval, obovate or wedge-lanceolate, acuminate, 2' to 3' long, sharply serrate, dark green and nearly smooth above, paler and pubescent beneath, *turning black in autumn*. Flowers all on very short peduncles, with the parts of the fertile ones usually in 6's, rarely in 5's, 7's, or 8's; those of the sterile in 4's, 5's, or 6's. Drupes scarlet, rarely white, 3'' in diameter, in little, *apparently verticillate clusters*, 6-celled, 6-seeded. June, July.

7. *I. laevigata*, GRAY. SMOOTH WINTERBERRY. An erect shrub, 6° to 9° high, of erect habit and gray, warty branches, found in swamps and wet grounds, from Me. to Va. It resembles the preceding species, but has its leaves lanceolate, appressed-serrulate, smooth on both sides, shining above, and *turning yellow in autumn*. Sterile flowers, solitary or sometimes 2 together on slender stalks 6'' to 9'' long; the fertile peduncles much shorter, with orange-red drupes larger than those of No. 6 and ripening sooner on very thick stalks. May, June.

8. *I. glabra*, GRAY. INKBERRY. EVERGREEN WINTERBERRY. A handsome shrub, 2° to 4° high, with coriaceous, evergreen leaves, found in sandy soils, swamps, and pine barrens from Mass. to Fla. and La., chiefly near the coast. Leaves smooth, shining, dark green above, paler and often black-dotted beneath, wedge-lanceolate, somewhat toothed toward the apex, 1' to 2' long, on short petioles. Drupes black, 2'' to 3'' in diameter, solitary, on peduncles 5'' long. Nutlets smooth. June, July.

ORDER 29. CELASTRACEÆ—STAFF-TREE FAMILY

Shrubs or trees, with simple leaves, minute, caducous stipules or none, and small, regular, 4 to 5-merous perigynous flowers. Sepals and petals imbricated in bud. Stamens as many as and alternate with the petals, and inserted on a disk filling the bottom of the calyx and sometimes covering the 2 to 5-celled ovary. Fruit 2 to 5-celled, free from the calyx. Seeds few, albuminous, ariled.

Key to Genera

Woody vines. Leaves alternate	CELASTRUS	I
Erect or decumbent shrubs. Leaves opposite	EUONYMUS	11

I. CELÁSTRUS, L. STAFF TREE. Mostly climbing shrubs, with alternate, petioled, usually deciduous leaves, and inconspicuous, greenish-white, diœcious or polygamous flowers in terminal or axillary clusters. Calyx cup-shaped, 5-cleft. Petals and stamens 5. Capsule globose, 3-celled, 3-valved, loculicidal. Seeds 1 or 2 in each cell, inclosed in a scarlet aril.

1. *C. scândens*, L. SHRUBBY OR CLIMBING BITTERSWEET. WAXWORK. A twining shrub, growing in rich soils along streams, in thickets, and over fences, from Me. to N.C. west to Minn. and Kan. Leaves smooth, oblong-ovate, pointed, finely serrate, 2' to 4' long. Flowers greenish, 2'' across, in compound, terminal racemes. The capsules, 4'' to 5'' in diameter, and resembling in appearance orange-colored berries, open in autumn, and displaying the handsome scarlet aril, remain on their stems through the winter. June.

II. EUÓNYMUS, Tourn. SPINDLE TREE. Erect, procumbent, or trailing shrubs, with 4-angled branches, opposite, simple, deciduous or evergreen leaves, and small, perfect, greenish or purple flowers in loose cymes on axillary peduncles. Calyx flat, 4 to 5-cleft. Petals 4 to 5, spreading, inserted beneath a 4 to 5-lobed disk covering the ovary. Stamens 4 to 5, very short, inserted on the disk. Style very short or none. Capsule 3 to 5-celled, loculicidally 3 to 5-valved. Seeds 1 to 4 in each cell, inclosed in a red, pulpy aril.

1. *E. atropurpûreus*, Jacq. BURNING BUSH. WAHOO. A tall, upright shrub or small tree, 6° to 20° high, in low, shady woods from N.Y. to Neb. south to Fla. Leaves deciduous, *petiolate*, elliptic-ovate, 2' to 5' long, pointed, finely serrate. Peduncles flattened, many-flowered. Flowers dark purple, the parts usually in 4's. Capsules crimson, smooth, deeply 3 to 4-lobed, drooping, on long peduncles. June.

2. *E. Americânus*, L. STRAWBERRY BUSH. An upright or straggling shrub, 2° to 8° high, of low, moist woods and river banks from southern N.Y. to Ill. south to Fla. and Tex. Branches 4-angled, ash-colored, at wide angles with the stem. Leaves oval to oblong-lanceolate, crenulate, 1' to 3' long, *bright green, thickish, almost sessile*. Peduncles slender, 6'' to 12'' long, 1 to 3-flowered. Flowers greenish-purple, with the parts mostly in 5's. Capsules rough, warty, depressed, crimson, 3 to 5-lobed. June.

3. *E. obovâtus*, Nutt. RUNNING STRAWBERRY BUSH. A more common shrub than No. 2, in low, wet grounds from N.Y. to Pa., Ind., and Ky., regarded by some as merely a variety, but recognized by others as a distinct species. With similar flowers and fruit, it differs mainly in having its stem procumbent, with erect branches, 1° to 2° high, or decumbent, rarely rising more than 1° from the ground, and in either case rooting from the trailing stem or branches. *Leaves obovate, 1' to 2' long, dull, thin, cuneate at base, and petioled.* April, May.

4. *E. Japónicus*, Thun. JAPANESE STRAWBERRY TREE. CHINESE

Box. An erect, Asiatic, evergreen shrub, 8° to 16° high, cultivated and hardy in the southern U.S. Leaves shining, bright green, obovate to narrowly elliptic, 18" to 30" long, obtusely serrate, with a cuneate, acute, or obtuse base. Flowers greenish-white, with the parts in 4's, in several-flowered cymes on slender peduncles. Capsules pink, smooth, depressed-globose. Many varieties are cultivated. June, July.

ORDER 30. RHAMNACEÆ — BUCKTHORN FAMILY

Erect or climbing, often thorny shrubs or small trees, with simple, usually alternate leaves, and small, regular, perfect or polygamous, sometimes apetalous flowers, usually in axillary or terminal clusters. Stipules small, deciduous. Calyx 4 to 5-toothed. Petals 4 to 5, or wanting. Stamens perigynous, as many as and opposite the petals and inserted with them into the edge of the fleshy disk in the short tube of the calyx. Fruit a drupe or capsule usually 2 to 4-celled, with 1 seed in each cell.

Key to Genera

Erect shrubs or trees. Flowers in axillary clusters	RHAMNUS	I
Erect or depressed shrubs. Flowers in terminal clusters	CEANOTHEUS	II
Twining and climbing shrubs. Flowers in terminal panicles	BERCHEMIA	III

I. RHAMNUS, L. BUCKTHORN. Shrubs or small trees, with petiolate, feather-veined, deciduous or evergreen, mostly alternate leaves, and small, greenish, perfect, diœcious or polygamous flowers in axillary clusters. Calyx tube bell-shaped, lined with the disk, 4 to 5-toothed. Petals 4 to 5, small, short-clawed, concave, often wanting. Stamens 4 to 5. Ovary free, 2 to 4-celled. Drupe usually black, rarely red, berry-like, inclosing 2 to 4 seed-like, cartilaginous nutlets.

1. R. cathartica, L. COMMON BUCKTHORN. An Old World, *thorny* shrub, 6° to 20° high, cultivated for hedges, and sparingly naturalized in New Eng. and the eastern parts of the Middle States. Leaves dark green, broadly ovate or elliptical, 18" to 30" long, minutely serrate, smooth, petiolate. Flowers appearing just after the leaves, diœcious, greenish, 1" wide, with calyx teeth, petals, and stamens in 4's. Drupes black, shining, globose, about 4" in diameter, with 3 to 4 grooved nutlets. The berries are severely cathartic and yield a dye. May, June.

2. R. lanceolata, PURSH. LANCE-LEAVED B. A tall, *thornless*, upright shrub, with smooth, grayish bark, 4° to 8° high, in moist soils and on river banks from Pa. to Neb. south to Ala. and Tex. Leaves lanceolate or ovate-lanceolate, 1' to 3' long, acute at each end, serrulate, smooth or nearly so above, somewhat pubescent beneath. Flowers yellowish-green, nearly 2" wide, polygamous or diœcious, 2 to 3 together, appearing with the leaves. Petals, stamens, and calyx teeth in 4's. Drupes dark red or black, globose, 3" in diameter, with 2 grooved nutlets. May.

3. *R. Caroliniæna*, WALT. CAROLINA B. INDIAN CHERRY. A tall, thornless shrub, of swamps, low grounds, and river banks from N.J., Va., and Ky. to Kan. south to Fla. and Tex. Leaves elliptic or oblong-oval, 3' to 5' long, acute at both ends, obscurely serrulate, nearly smooth, deciduous. Flowers perfect, with the parts in 5's, greenish or whitish, about 1" wide, in axillary, peduncled umbels, or solitary on short, axillary peduncles. Petals minute. Drupes globose, about 4" in diameter, purple, sweet, with the 3 nutlets not grooved. May, June.

II. *CEANOTHUS*, L. Thornless shrubs or undershrubs, with mostly alternate, 3-ribbed, petioled leaves, and small, perfect, 5-merous, white, blue, purplish, or yellowish flowers in showy, terminal clusters. Petals 5, spreading, hood-shaped, on slender claws. Stamens with long filaments. Ovary 3-celled, becoming an obtusely triangular, 3-celled, 3-seed decape-sule, inclosed at the base by the persistent calyx tube. The *stamens*, *calyx*, and *pedicel* are all colored like the petals.

1. *C. Americanus*, L. NEW JERSEY TEA. REDROOT. A small shrub, 1° to 3° high, with a large, red root, found in open woodlands from Canada to Fla. and Tex. Leaves ovate or oblong-ovate, 1' to 3' long, strongly 3-ribbed, serrate, tapering at the apex, obtuse or subcordate at the base, finely pubescent, on petioles 2" to 4" long. Flowers white, in little umbels clustered in dense, terminal panicles or corymbs. The leaves were used for tea during the American Revolution. The root is sometimes used for dyeing. July.

III. *BERCHÈMIA*, NECKER. Climbing or erect, thornless shrubs, with alternate, feather-veined, petioled, coriaceous, deciduous, minutely stipulate leaves, and small, greenish-white flowers mostly in terminal panicles. Calyx 5-parted, with hemispheric tube. Petals 5, sessile, oblong, acute, concave, inclosing the 5 short stamens. Disk filling the calyx tube and covering but not cohering with the ovary. Drupe oval or oblong, flattened, with a thin flesh and a bony, 2-celled stone.

1. *B. volàbilis*, DC. SUPPLE-JACK. A climbing, woody twiner, of low woods and damp, rich soils from Va. to Mo. south to Fla. and Tex. Stem very supple, tough, with smooth, reddish bark, and slender, terete, pendent branches, climbing tall trees. Leaves smooth, dark green above, on slender petioles, 2" to 5" long, ovate or ovate-oblong, 1' to 2' in length, acute, acuminate or obtuse, with 9 to 12 pairs of straight and parallel, pinnate veins. Flowers 1" to 2" wide. Drupes 3" to 4" long, on pedicels about as long. May, June.

ORDER 31. VITACEÆ — VINE FAMILY

Shrubs, mostly climbing, with watery juice, tumid joints, alternate, petioled, palmately veined or compound leaves, often opposite tendrils or flower clusters, and small, regu-

lar, perfect, polygamous or diœcious flowers in racemes, panicles, or cymes. Stipules small, caducous. Calyx minute, truncated, the limb obsolete, or 4 to 5-toothed. Petals 4 or 5, distinct or united, valvate, hypogynous, perigynous, caducous. Stamens 4 or 5, opposite the petals, inserted usually between the lobes of a disk surrounding the ovary. Fruit usually a 2-celled, 4-seeded berry. Seeds bony, with hard albumen.

Key to Genera

Ovary with a disk. Tendrils naked-tipped	VITIS I
Ovary without a disk. Tendrils with dilated tips	AMPELOPSIS II

I. VITIS, L. GRAPEVINES. Woody vines, mostly climbing by naked-tipped tendrils, with simple, rounded, cordate leaves, and fragrant, 5-merous, polygamous, diœcious or perfect flowers in a compound thyrse. Petals cohering at the top and separating only below, so as to fall off without expanding. Berry pulpy, 1-celled, with 1 to 4 pear-shaped seeds.

a. Bark in loose shreds. Tendrils forked. (b)	
a. Bark not in loose shreds. Tendrils not forked	No. 7
b. Tendrils or flower clusters <i>continuous</i> ; i.e. one or the other opposite each leaf	No. 1
b. Tendrils or flower clusters <i>intermittent</i> ; i.e. both absent opposite each 2d or 3d leaf. (c)	
c. Leaves downy	No. 2, 3
c. Leaves smooth. (d)	
d. Flowers not all perfect	No. 4, 5
d. Flowers all perfect. Exotic	No. 6

1. V. Labrusca, L. NORTHERN FOX GRAPE. A strong, climbing or trailing vine, of moist woods from New Eng. to Minn. south to Ga. and Tenn. Young shoots and leaves rusty-woolly, sometimes whitish-woolly. Tendrils forked. Pith interrupted by the solid nodes. Leaves large, 4' to 6' wide, thick, strongly veined, broadly ovate-cordate, slightly dentate, or deeply lobed. Berries large, 8'' to 9'' in diameter, usually purplish-black, varying to reddish-brown or amber-green, with a sweetish-musky pulp, thick, tough skin, and 3 to 6 seeds, ripening in Sept. or Oct. The parent of most of the American cultivated grapes, especially the *Concord*, *Catawba*, and *Hartford*, and in part of the *Isabella* and *Delaware*. June.

2. V. æstivâlis, Mx. SUMMER G. PIGEON G. BUNCH G. A long, slender vine, common in woods and thickets from southern New Eng. to Wis. south to Fla. and La. Tendrils and flower clusters intermittent, i.e. lacking opposite each second or third leaf. Twigs and petioles smooth or pubescent. Leaves very variable, 4' to 7' wide, dentate, more or less cordate-ovate in outline, with 3 to 5 shallow or deep lobes; the dull upper surface becoming smooth, but the lower covered with a reddish-brown fuzz. Berries in long and long-stalked, compact clusters, 4'' to 5'' in diameter, deep blue or black, *glaucous*, with 2 to 3 seeds, ripening in Sept. The parent of the *Herbemont*, *Norton's Virginia*, and others. May, June.

3. *V. cinerea*, ENGELM. DOWNY G. SWEET WINTER G. A high-climbing vine, found along streams from Ill. to Kan. south to Tex. and in northern Fla. Branchlets angular, with persistent, grayish or whitish down or wool. Leaves broad-cordate, with a sharply 3-lobed top, dentate or entire, on long petioles. Berries small, 3" to 4" in diameter, *black without bloom*, with 1 to 2 seeds, in long-stalked clusters, ripening late, and pleasantly sweet after frost.

4. *V. cordifolia*, Mx. FROST G. CHICKEN G. WINTER G. A high climber, found in moist thickets from New Eng. to Neb. south to Fla. and Tex. Leaves heart-shaped, acuminate, 3' to 5' wide, coarsely and sharply toothed, *smooth and shining above*, with short hairs on the veins beneath. Stipules small. Berries small, 3" in diameter, with 1 to 2 large seeds, black, shining, very sour until mellowed by sharp frost. May, June.

5. *V. riparia*, Mx. RIVER-BANK G. FROST G. A vigorous climber, along the banks of streams from western New Eng. to Pa. west to Minn. and Kan. It differs from No. 4 in its larger and more persistent stipules, 2" to 3" long, its more glossy leaves, which are also more frequently or more deeply 3-lobed, and in its bluish-black *glaucous*, sweet and juicy berries, 4" to 5" in diameter, ripening from July to Sept. May, June.

6. *V. vinifera*. EUROPEAN G. WINE G. The Old World species, cultivated from the remotest antiquity for making wine, and cultivated in this country chiefly in greenhouses or hothouses or in the California vineyards. Leaves usually circular in outline, cordate, sinuately 5-lobed, smooth, green, shining, with deep and sharp teeth. *Flowers all perfect*. Berries usually oval or oblong. By cultivation developed into endless varieties. *Black Hamburgs* and *Barbarossas* are among its hothouse varieties.

7. *V. rotundifolia*, Mx. SOUTHERN FOX G. MUSCADINE. BULLACE. A trailing or climbing vine, sometimes 60° to 100° long, of moist, often sandy soils from Md. to Kan. south to Fla. and Tex. Bark smooth, pale, closely adherent; nodes pierced by the pith; and tendrils simple, not forking, intermittent. Leaves small, 2' to 3' wide, dark green, smooth and shining on both sides, rounded, coarsely and bluntly toothed, deeply cordate at the base. Panicles of flowers small, dense. Berries large, 6" to 9" in diameter, purplish, with a musky flavor, a tough, thick skin, and several flat, wrinkled seeds. Ripens early in autumn. The original of the *Scuppernong* G. May.

II. AMPELÓPSIS, Mx. Climbing or trailing shrubs, with tendrils commonly attaching themselves by dilated tips, leaves usually digitate, and small, greenish, mostly perfect flowers in compound cymes or panicles opposite the leaves or terminal. Calyx slightly 5-toothed. Petals concave, thick, expanding before they fall. Disk none.

1. *A. quinquefolia*, Mx. VIRGINIA CREEPER. AMERICAN IVY. A common woody vine, from Me. to Dak. south to Fla. and Tex. Leaves digitately 5-foliolate, with smooth, lance-ovate, acuminate, coarsely toothed leaflets, tapering at the base sometimes to a petiole, turning bright crimson in autumn. Berries dark blue or black, the size of peas, on red pedicels and peduncles, ripening in Oct. July.

2. *A. tricuspidata*, SIEB. AND ZUCC. (*A. VEITCHII* of the gardeners.) JAPANESE IVY. BOSTON IVY. A hardy, profusely branching climber from Japan, frequently cultivated for covering and adorning walls. Tendrils short, with many disk-bearing branches. Leaves smooth and shining on both sides, turning orange and scarlet in autumn, very variable in shape, roundish-ovate, with crenate-serrate margin or cordate and 3-lobed, or 3-foliolate. Cymes inconspicuous.

ORDER 32. SAPINDACEÆ — SOAPBERRY FAMILY

Trees or shrubs, rarely herbs, with alternate or opposite, simple or compound leaves, usually irregular and unsymmetrical flowers, with the imbricated sepals and petals in 4's or 5's. Stamens 5 to 10, inserted on a perigynous or hypogynous disk. Ovary 2 to 3-celled and lobed, with 1, 2, or rarely more ovules in each cell. Embryo mostly curved or convolute. Albumen little or none.

Key to Genera

Flowers irregular. Trees or shrubs	ÆSCULUS	I
Flowers irregular. Climbing herbs	CARDIOSPERMUM	II
Flowers regular, perfect. Fruit an inflated pod	STAPHYLEA	III
Flowers regular, polygamous. Leaves simple	ACER	IV
Flowers regular, dioecious. Leaves compound	NEGUNDO	V

I. ÆSCULUS, L. HORSE-CHESTNUT. BUCKEYES. Trees or shrubs, with opposite, petioled, digitately compound leaves, and irregular, unsymmetrical, polygamous flowers in dense, showy, terminal panicles. Leaflets 5 to 9, serrate and straight-veined like those of the chestnut. Calyx bell-shaped, 5-lobed or -toothed. Petals 4 to 5, clawed, unequal. Stamens 6 to 8, usually 7, distinct, with long, slender, often unequal filaments inserted on a hypogynous disk. Style 1. Ovary 3-celled, with 2 ovules in each cell. Fruit a leathery, smooth or spiny capsule, 2 to 3-valved, usually by abortion yielding but 1 or 2 large, smooth seeds with shining coat and scar suggesting a chestnut or a buck's eye. Cotyledons thick and fleshy

Fruit prickly, at least when young. Petals 5	No. 1
Fruit prickly, at least when young. Petals 4. Tree	No. 2
Fruit prickly, at least when young. Petals 4. Shrub	No. 3
Fruit smooth. Flowers yellow	No. 4
Fruit smooth. Flowers red	No. 5
Fruit smooth. Flowers white	No. 6

1. Æ. Hippocástanum, L. HORSE-CHESTNUT. A large, Old World tree, widely cultivated for shade and ornament, somewhat escaped from cultivation in southeastern N.Y. and N.J. Leaves long-petioled, nearly smooth, with mostly 7 obovate, wedge-shaped, abruptly acuminate, serrate leaflets; 4' to 8' long. Flowers large, with 5 white, spreading petals, spotted with yellow and crimson, shorter than the stamens, in panicles 8' to 12' long. Fruit globose, spiny. June.

2. Æ. glàbra, WILLD. FETID OR OHIO BUCKEY. A small or medium-sized tree, with rough, fetid bark, found along river banks and in woods from western Pa. to Mich. and Kan. south to Ala. Leaves long-petioled, with usually 5 oval to lanceolate, finely serrate, nearly smooth leaflets,

3' to 6' long. Flowers pale yellow, with 4 slender-clawed petals, much shorter than the curved stamens, in loose panicles 5' to 6' long. Fruit prickly when young, becoming somewhat smooth when mature. May.

3. *Æ. arguta*, BUCKL. SHRUBBY OR WESTERN B. A shrub, with smooth bark, 3° to 10° high, of Kan. and southward to Tex. Leaflets 7 to 9, narrowly lanceolate, acuminate, 3' to 4' long, unequally serrate. Flowers yellow, with a reddish center, in dense panicles 4' to 6' long. Fruit when young very prickly. March, April.

4. *Æ. flava*, AIT. BIG B. SWEET B. YELLOW B. A large tree, with dark brown, scaly bark, common in rich woods of the Mississippi Valley, becoming a small tree or shrub in parts of Ga. Leaflets 5, rarely 7, smooth above, pubescent beneath, elliptic or oblong-ovate, acuminate, serrulate, 4' to 7' long. Flowers light yellow, with 4 connivent petals longer than the stamens and on long claws, the upper pair longer than the lower. Panicle loose. Fruit smooth. Var. *purpurascens*, GRAY. PURPLISH B., with flesh-colored or dull purple flowers and more strongly serrate leaflets generally downy underneath, occurs in W. Va. and southward and westward. April, May.

5. *Æ. Pavia*, L. RED B. A shrub or small tree, from 4° to 20° high, found in rich soil from Va. to Fla. west to Mo. and Ark. Leaves of a rich glossy green, with purple petioles and veins, and 5 to 7 oblong-lanceolate, finely serrate leaflets 3' to 5' long. Flowers bright red or purplish, in a loose, thyrsoid raceme. Calyx tubular, toothed. Petals 4, the 2 upper longer than the lower and about equaling the 8 stamens. Fruit smooth. April, May.

6. *Æ. parviflora*, WALT. SMALL B. A handsome shrub, 3° to 10° high, of upper Ga. and S.C., cultivated for ornament farther north. Leaflets 5 to 7, oblong-ovate, finely serrate, velvety-downy beneath. Flowers white, very numerous, in a slender, raceme-like panicle 8' to 16' long. Petals 4, narrow, erect, only one third the length of the 6 or 7 capillary stamens; their claws longer than the obconical calyx. Fruit smooth. Seeds small. July, Aug.

II. *CARDIOSPERMUM*, L. Climbing herbs, with alternate, biternate leaves, cut-toothed leaflets, small, white flowers in axillary racemes or corymbs, with the lowest pair of pedicels changed to tendrils, and membranous, inflated, capsular fruit. Sepals 4, the 2 outer smaller. Petals 4, each with a petal-like scale at the base within. Stamens 8, unequal. Style short, 3-cleft. Ovary 3-celled, 1 ovule in each cell. Capsules 3-lobed.

1. *C. Halicababum*, L. BALLOON VINE. HEARTSEED. A smooth or slightly pubescent, slender, climbing herb, with grooved stem, 6° to 10° long, native along the Missouri River and its branches, and sometimes cultivated for its curious fruit. Leaflets ovate-lanceolate, coarsely toothed. Capsule globular-pear-shaped, 1' long. Seeds bony, globose, nearly black, with a *heart-shaped aril*, giving rise to the second of the common names given above, which is the translation of the generic name. July.

III. *STAPHYLÆA*, L. BLADDER NUTS. Erect shrubs, with opposite, pinnate, 3 to 7-foliolate, stipulate leaves, drooping racemes or panicles of white flowers, and capsular, bladder-like fruit. Calyx deeply 5-parted, colored, persistent; lobes erect.

Petals 5, spatulate, erect, equaling the calyx, inserted on a perigynous disk lining the base of the calyx. Styles 3. Capsule 2 to 3-celled, 2 to 3-lobed, thin, membranaceous, inflated, opening at the top when ripe. Seeds bony, 1 to 4 in each cell.

1. *S. trifolia*, L. AMERICAN BLADDER NUT. A handsome shrub, with greenish, striped branches, 6° to 15° high, of woods and thickets from Me. to Minn. south to S.C. and Mo. Leaves ternate; leaflets ovate, acuminate, serrate, pale and slightly pubescent or smooth beneath, 1' to 3' long. Stipules and stipels caducous. Flowers bell-shaped, in a short, drooping raceme. Capsules 2' long, 1' wide. May.

IV. *ÁCER*, L. MAPLES. Trees or sometimes shrubs, with opposite, simple, long-petioled, palmately lobed, exstipulate leaves, regular, polygamous or diœcious, often apetalous flowers, in axillary or terminal clusters, and a 2-winged fruit. Calyx colored, usually 5-parted, the divisions imbricated. Petals usually 5 or none; the claws, if any, inserted on a lobed, perigynous or hypogynous disk. Stamens 4 to 12, usually 8. Styles 2. Ovary 2-celled, 2-lobed, becoming in fruit 2 long-winged samaras, each by abortion 1-seeded, united at the base, at length separating. Embryo coiled or folded with long, thin cotyledons. Albumen none.

Flowers in fascicles, opening before the leaves	Nos. 1, 2
Flowers in pendulous corymbs, opening with the leaves	Nos. 3, 6
Flowers in racemes, opening after the leaves	Nos. 4, 5, 7

1. *A. dasycarpum*, EHRH. WHITE OR SILVER M. SOFT M. RIVER M. A large tree, with spreading branches, growing along streams from Me. to Fla. west to Dak. and Kan. Leaves deeply 5-lobed with acute sinuses, cut-lobed, toothed, rather narrow segments, and truncate or somewhat cordate base; green above, *silvery white* and when young more or less downy *beneath*; turning yellow in autumn. Flowers preceding the leaves, greenish-yellow, on short pedicels, in simple umbels from separate lateral buds, apetalous, *with downy ovaries* (*dasycarpum*). Fruit with large, divergent wings, about 2' long, one sometimes not developed. March, April.

2. *A. rubrum*, L. RED OR SCARLET M. WATER M. SWAMP M. A large or small tree, according to the region, common in swamps and low woods from Me. to Fla. and Tex. Leaves varying greatly in size, outline, lobing, etc., but in general 3 to 5-lobed, with the sinuses acute, the lobes irregularly and sharply notched and toothed, pale and whitish or glaucous beneath, and turning to a rich crimson or scarlet in early autumn. Flowers red, scarlet, or rarely yellowish, considerably preceding the leaves, with 5 linear-oblong petals and 3 to 6 stamens, in lateral clusters on very short pedicels which lengthen and droop in fruit. Ovaries and samaras smooth. March, April.

3. *A. saccharinum*, WANG. (*A. SACCHARUM*, MARSH.) SUGAR M. HARD M. ROCK M. A large tree, in rich woodlands from Me. to Neb. south to Fla. and Tex., especially in the Northern States and along the mts. Leaves whitish and smooth or slightly downy on the veins

beneath, 3 to 5-lobed, with the *sinuses rounded* and the lobes with 1 or 2 remote, sinuate, blunt-pointed teeth; the base more or less cordate. They turn bright yellow or scarlet in autumn. Flowers greenish-yellow, apetalous, opening with the leaves, in lateral and terminal pendulous corymbs. Fruit smooth, drooping on slender pedicels 1' to 2' long, with slightly diverging wings 1' long. *Var. nigrum*, TORR. AND GRAY. **BLACK SUGAR M.** A tree somewhat smaller than the type, by some regarded as a distinct species, differing mainly in having a darker bark and foliage, with the lobes of the leaves often entire, the 2 lower ones small or reduced to mere curves. April.

4. *A. Pennsylvanicum*, L. **STRIPED M. MOOSEWOOD. WHISTLEWOOD.** A small tree, 10° to 25° high, with smooth, light green bark, striped vertically with darker lines, growing in rocky woods from Me. to Wis. and south in the mts. to Ga. and Tenn. Leaves large, 5' to 6' long, bright green turning clear yellow in autumn, thin, finely serrate, with rounded base, and 8 short, acute or acuminate lobes at the upper end, with acute sinuses between, the whole suggestive of a name sometimes given, *Goosefoot M.* Flowers appearing after the leaves, greenish, with obovate petals, in *loose terminal drooping racemes*. Fruit smooth. Wings 1' long, widely divergent. Cultivated for ornament in Europe. May.

5. *A. spicatum*, LAM. **MOUNTAIN M.** A shrub, 6° to 15° high, or rarely, in some regions, a small tree, 20° to 30° high, in damp rocky woods from Me. to Minn. and south along the mts. to N.C. and Tenn. Leaves roundish, 2' to 4' long, with 3 somewhat pointed, coarsely toothed lobes, downy beneath, and turning yellow and scarlet in autumn. Flowers appearing after the leaves, greenish-yellow, with narrow petals, in *erect, rather dense, compound racemes* becoming somewhat drooping in fruit. Samaras small. Wings slightly divergent. June.

6. *A. platanoides*, L. **NORWAY M.** A large, round-headed, European tree, widely cultivated. Leaves thin, broad, 5' to 7' across, smooth, bright green, in shape resembling those of the Sugar Maple, but with a milky juice, remaining green later than other maples and turning pale yellow in autumn. Fruit smooth, with wings 2' long, diverging very widely. Varieties with cut and variegated leaves occur. May.

7. *A. Pseudo-Platanus*, L. **SYCAMORE M.** A large, European tree, widely cultivated in many varieties. Leaves resembling those of No. 6 in general outline, and 4' to 7' wide, but with the lobes coarsely crenate or serrate, deep green above, whitish and glaucous beneath. *Flowers greenish, in pendulous racemes*. Fruit smooth. Wings moderately diverging. April, May.

IV. NEGÚNDO, MOENCH. Trees, with opposite, pinnately compound leaves, and small, dioecious flowers without petals or disk. Staminate flowers in fascicles, pistillate in racemes. Calyx, stamens, and fruit as in *Acer*.

1. *N. aceroides*, MOENCH. (*ACER NEGUNDO*, L.) **BOX ELDER. ASH-LEAVED MAPLE.** A small or medium-sized tree, found along streams from Vt. to Dak. south to Fla. and Tex. Bark of young trees smooth and yellowish-green. Leaves downy when young, nearly smooth when old, usually with 3, sometimes 5 to 7, petiolate, ovate or oval, irregularly and remotely coarse-toothed, acute or acuminate leaflets 2' to 5' long. Flowers appearing with the leaves, the staminate on long, slender pedicels; the pistillate on a different tree, in drooping racemes 6' to 8' long. Samaras smooth, 12" to 18" in length. April.

ORDER 33. ANACARDIACEÆ — CASHEW OR SUMAC FAMILY

Trees or shrubs, with a resinous or milky acrid juice, alternate, dotless, simple or compound leaves, and small, perfect, polygamous or dioecious, mainly regular flowers, and mostly drupaceous fruit. Calyx divisions, petals, and stamens of the same number, 3 to 7, usually 5, the petals sometimes wanting, and the perigynous stamens separate or united. Ovary free, 1-celled, 1-ovuled, with 3 styles or stigmas.

I. RHUS, L. SUMACS. Shrubs or small trees, with alternate, exstipulate, compound or sometimes simple leaves, and small, polygamous, dioecious, or perfect flowers, in axillary or terminal panicles. Calyx usually 5-cleft, persistent. Petals imbricated. Stamens alternate with the petals and inserted on a disk surrounding the base of the ovary. Styles 3. Drupe small, dry, indehiscent, roundish, 1-seeded, smooth or downy.

Leaves simple. Flower clusters feathery in fruit	Nos. 8, 9
Leaves ternate	Nos. 6, 7
Leaves pinnate. Flowers in terminal thyrses	Nos. 1 to 4
Leaves pinnate. Flowers in axillary panicles	No. 5

1. R. glabra, L. SMOOTH S. SCARLET S. A shrub, 6° to 15° high, or rarely a small tree, of dry soils from Me. to Dak. south to Fla. and Miss. *Leaves and branches smooth.* Leaflets 11 to 31, 2' to 4' long, lanceolate or oblong-lanceolate, sessile except the terminal one, serrate, acuminate, rounded or oblique at the base; dark green above, whitish beneath; not winged between the leaflets. Flowers polygamous, green, in dense, thyrsoid panicles, the grayish down of the ovaries becoming the acid, crimson hairs which cover the globular drupes. Stone of drupe smooth. The drupes are used for dyeing red. The leaves and bark of this as well as of other species are rich in tannin and are used for tanning leather. June, July.

2. R. typhina, L. STAGHORN S. VIRGINIAN S. A larger shrub than the preceding, 10° to 20° high and frequently more tree-like in its dimensions, common in the same soils and with about the same range. It differs from it mainly in the *velvety pubescence of its twigs and petioles*, whence its name "Staghorn S." The leaflets are usually longer, 3' to 5', than in No. 1, and not oblique at the base. In other respects they are about the same. The sulphur-yellow, aromatic wood is used in dyeing. June.

3. R. copallina, L. MOUNTAIN S. DWARF S. A shrub, smaller than No. 2, of the same habitat and range. It differs from both the preceding species chiefly in having the *main petioles winged between the leaflets* and its 9 to 21 leaflets mostly entire or with a few teeth toward the apex. Pubescent branches and petioles also distinguish it from No. 1. July.

4. *R. pàmila*, Mx. A low, procumbent shrub, of the mts. and pine barrens of Ga. and N. C., with branches 1° to 2° high. Branches and petioles tomentose. Leaflets 11 to 13, sessile, oval or oblong, acute, coarsely serrate, pale and tomentose beneath. Flowers and fruit as in all the preceding species. Represented by some authorities as *very poisonous*.

5. *R. venenàta*, DC. POISON SUMAC. P. ELDER. P. ASH. P. DOGWOOD. A shrub, 10° to 16° high, or a small tree, of the same range as all the preceding, but found usually only in swamps. Generally smooth. Leaflets 7 to 13, thin, oval, ovate or obovate, 2' to 4' long, abruptly acuminate, with the *edge entire*, which distinguishes it from Nos. 1, 2, and 4, and the *main petiole red and not winged* between the leaflets, which distinguishes it from No. 3. It is still further distinguished from all the preceding by *having its flowers in loose, axillary panicles, followed by smooth, whitish drupes*. Stone of the drupe striate or ridged. In flower and fruit this species resembles the next. The *most poisonous species*, reputed to taint the air around it. June.

6. *R. Toxicodéndron*, L. POISON IVY. POISON OAK. A low, erect shrub, or more commonly a woody vine, climbing by aerial rootlets, in thickets, along fences and over rocks, or ascending trees, everywhere from Me. to Fla. and Ark. Leaves petioled, leaflets 3, broadly oval or ovate, 2' to 4' long, entire or variously notched or sinuate. Flowers dioecious, greenish, in loose, axillary panicles. Drupes in fruit naked and whitish as in those of No. 5. *Poisonous*. The variety *radicans* is by some regarded as a distinct species. May, June.

7. *R. aromática*, Ait. (*R. CANADENSIS*, MARSH.) SWEET S. FRAGRANT S. A straggling, aromatic bush, 3° to 7° high, of dry, rocky banks and woods from Vt. to Minn. and south to Fla. and La. Leaves petioled, with 3 incisely crenate leaflets, each 1' to 2' long, the lateral ones ovate and sessile, the terminal one rhombic, with a short stalk. Flowers yellowish, dioecious, in short, bracted, solitary or clustered spikes preceding the leaves. Fruit red, hairy. *Not poisonous*. The *crushed leaves are fragrant*. May.

8. *R. Cótinus*, L. VENETIAN S. SMOKE TREE. MIST TREE. An ornamental, European shrub, 5° to 9° high, with simple, entire, obovate, *coriaceous leaves, rounded at both ends*, on slender petioles, and small, perfect, mostly abortive flowers, in large, loose, terminal, compound panicles. The long pedicels become profusely feathery and give the shrub the *smoky or misty appearance* indicated by two of its common names.

9. *R. cotinoides*, Nutt. AMERICAN SMOKE TREE. CHITTAMWOOD. A small tree, 25° to 40° high, of Tenn. and Ala. and westward to Mo. and Ind. Terr., nearly allied to and resembling No. 8, but with the leaves thin, oval, acute at base, and smooth, 6' to 9' long. The orange-yellow wood yields a dye. April, May.

ORDER 34. POLYGALACEÆ—MILKWORT OR POLYGALA FAMILY

Herbs, or in warm regions rarely shrubs or small trees, with alternate, sometimes opposite or whorled, simple, entire, exstipulate leaves, irregular, perfect, hypogynous flowers, and capsular, berry-like, or drupaceous fruit. Sepals 5, distinct, very unequal, the 2 inner (the wings) larger, petaloid. Petals 3, sometimes 5. Stamens 8 or 6,

rarely 5 or 4, monadelphous or diadelphous or rarely free. Ovary superior, compound, 2-celled, 2-ovuled.

I. POLÝGALA, Tourn. POLYGALA. MILKWORT. Bitter herbs, in temperate regions, with the chief characteristics those of the order given above. Further: petals 3, united by their claws to each other and to the stamen tube, the lower or middle one keel-shaped and usually crested on the back. Stamens 6 or 8, the filaments united below into a split tube. Anthers 1-celled. Fruit a small, 2-celled, 2-seeded, loculicidal capsule. Seeds with a caruncle.

Leaves alternate.

Flowers solitary, 1 to 4, purple	No. 1
Flowers racemed, purple	No. 2, 3
Flowers racemed, white	No. 4
Flowers in short spikes, purple	No. 5
Flowers in heads or short spikes, yellow	No. 6, 7

Leaves whorled.

Flowers in dense, short, conical spikes	No. 8
Flowers in slender, loose, rather long spikes	No. 9
Flowers in short, thick spikes or heads	No. 10

1. P. paucifolia, Willd. FRINGED POLYGALA. FLOWERING WINTERGREEN. A smooth perennial, of light soils in woods from Me. to Minn. south to Ga. and Ill. Stems slender, prostrate or subterranean, 6' to 15' long, with erect or ascending, simple branches 3' to 7' high, naked below, with several smooth, ovate, acute, entire leaves clustered near the summit. Flowers 1 to 4, solitary, axillary, rose-purple, rarely white, 8'' to 10'' long, with obovate wings, and a conspicuous, fringed crest on the keel. Cleistogamous flowers inconspicuous, greenish, lacking the wings of the calyx, near the ground or subterranean. May.

2. P. grandiflora, Walt. LARGE-FLOWERED P. A pubescent perennial, common in dry, light soils from S.C. to Fla. and westward, with branching stems 12' high, alternate, lanceolate leaves, and large flowers scattered in loose racemes 3' to 6' long. Flowers bright purple or rose-colored, becoming green. Wings large, erect, roundish. *Keel crestless.* Fruiting pedicels drooping. Caruncle inclosing the stalk of the oblong, hairy seed. July to Sept.

3. P. polygama, Walt. A smooth biennial, common in dry, sandy soils from Me. to Minn., Fla., and Tex. Stems many, mostly simple, very leafy, ascending, 6' to 12' high. Leaves oblanceolate or oblong-linear, obtuse, mucronate. Flowers rose-purple, many, in a loose, terminal raceme 1' to 4' long, on short, spreading or recurved pedicels. Wings obovate, longer than the crested keel. Bracts small, awl-shaped, caducous. Cleistogamous flowers, apetalous and wingless, many on prostrate or subterranean branches. June, July.

4. P. S  nega, L. SENECA SNAKE-ROOT. A smooth perennial, of several stems from a woody, contorted, branched rootstock, growing in rocky soils and woods from western New Eng. to Minn. and southward to N.C. and Mo. Stems 8' to 12' high, simple or somewhat branched above. Leaves scattered, lanceolate, serrulate, 1' to 2' long; the lowest ones small and scale-like. Flowers white or whitish, in a dense, terminal, slender spike, 1' to 2' long. Wings orbicular-ovate. Crest short, lobed. Lobes of the caruncle shorter than the hairy seeds. Rootstock about

6'' thick, of a sweet, nauseous taste, becoming hot and pungent. Medicinal. Var. *latifolia*, T. AND G., found in Pa. and Md. west to Ind., Mich., and Tenn., has stems more than 1° high, with ovate, acuminate leaves, acute at the base, and 2' to 4' long. July.

5. *P. sanguinea*, L. FIELD OR PURPLE P. An erect, smooth, leafy annual, 6' to 15' high, sparingly branched above, common in moist, sandy soils of fields and meadows from Me. to Minn. south to N.C. and west to Ark. and La. Stem angular. Leaves linear and lance-linear, 8'' to 15'' long, mucronulate. Flowers in dense, globular heads, or oblong, obtuse spikes 4'' to 5'' thick, bright rose-purple, sometimes paler. Wings oval or ovate, sessile. Crest minute. Bracts generally persistent. Caruncle nearly as long as the hairy, obovoid seeds. July to Sept.

6. *P. lutea*, L. ORANGE P. WILD BACHELOR'S BUTTON. A smooth biennial, of sandy plains and low pine barrens and swamps from N.J. to Fla. west to La. Stems 6' to 12' high, generally several, from fibrous roots, with a few spreading branches. Root leaves spatulate or obovate, obtuse; stem leaves lanceolate, ovate. Flowers orange-yellow, in ovate-globous heads, 8'' to 9'' thick. Pedicels longer than the bracts. Wings oblong-ovate, mucronate. Crest small. Linear caruncle lobes nearly as long as the hairy seed. June to Oct.

7. *P. nana*, DC. DWARF P. A low biennial, common in the pine barrens of the Southern States. Stems ascending, 2' to 4' high. Leaves spatulate or linear, 1' to 2' long, mostly radical and rosulate. Flowers citron-yellow, in dense, ovate heads becoming oblong, nearly 1' thick. Wings ovate-lanceolate, acuminate. Caruncle lobes half as long as the obovate, hairy seed. April, May.

8. *P. verticillata*, L. WHORLED P. A smooth, slender, branched annual, 6' to 10' high, common in fields or dry soils from Me. to Minn., Fla., and Tex. Leaves linear, acute, 4'' to 10'' long; those of the stem all whorled in 4's or 5's; those of the usually opposite branches, scattered. Flowers small, greenish-white or purplish, in peduncled, short, dense, conical spikes, 3'' to 10'' long. Wings broadly oval, clawed. Crest present. Caruncle 2-lobed, scarcely half as long as the hairy, oblong seed. July to Oct.

9. *P. ambigua*, NUTT. LOOSE-SPIKED P. A slenderer species than the preceding, with about the same range, but *with only the lower leaves whorled*, the rest as well as the branches being alternate, and *the flowers in long, slender, loose spikes*. Flowers somewhat larger and purple or purplish. Other features as in No. 8. July to Oct.

10. *P. cruciata*, L. CROSS-LEAVED OR MARSH P. MOSS P. A smooth, erect annual, 4' to 10' high, growing on the margins of swamps and in other, low or wet grounds from Me. to Minn., Fla., and La. Stem 4-sided, with the angles somewhat winged. Leaves linear-oblong or oblanceolate, in whorls of 4. Flowers rose-colored or greenish-purple, in dense, ovate sessile or nearly sessile spikes, 5'' to 9'' in diameter. Wings deltoid-ovate, cordate, acute or bristle-pointed. Crest small. Caruncle about as long as the seed. July, Aug.

ORDER 35. LEGUMINOSÆ — LEGUME OR PULSE FAMILY

Herbs, shrubs, or trees, with alternate, mostly compound and stipulate leaves, papilionaceous or regular flowers, monadelphous, diadelphous, or distinct stamens,

and a *single, free, simple pistil becoming in fruit a legume*. A very large order, usually divided into 3 large suborders which by some botanists are treated as distinct orders.

SUBORDER I. PAPILIONACEÆ—Pulse or Pea Subfamily

Herbs, shrubs, or trees, with simple or simply compound, mostly stipulate leaves, and truly *papilionaceous flowers* in which the upper and largest petal incloses the others in bud. (See also pp. 210, 211, of Lessons.) *Stamens* 10, rarely 5, sometimes distinct, but mostly monadelphous or diadelphous, especially the latter, in which 9 stamens form a cleft tube with the remaining upper one filling the cleft. Ovary 1-celled, or sometimes 2-celled by the intrusion of one or both sutures, or several-celled by constriction between the seeds, thus becoming a *lorent*. Seeds many or solitary, without albumen. Embryo with the radicle bent against the large cotyledons.

SUBORDER II. CÆSALPINEÆ—Brasiletto or Senna Subfamily

Trees, herbs, or shrubs, differing from those of suborder I mainly in having the *leaves sometimes doubly compound, the corolla nearly regular or only imperfectly papilionaceous, the upper petal being inclosed by the others, the stamens usually distinct* and the embryo straight.

SUBORDER III. MIMOSEÆ—Mimosa Subfamily

Herbs, shrubs, or trees, differing from those of both the preceding suborders, mainly in having the *leaves mostly 2 to 3-pinnate, the flowers perfectly regular, the calyx and corolla valvate in the bud, and the stamens often numerous and exserted*.

Key to Suborders and Genera

§ Corolla truly papilionaceous	Suborder I
§ Corolla imperfectly papilionaceous or nearly regular	Suborder II
§ Corolla regular and with the calyx valvate in the bud	Suborder III

A. Suborder I. Papilionaceæ

- a. Stamens 10, separate. (1)
 a. Stamens 10, monadelphous or diadelphous. (b)
 b. Leaves ending with a tendril. (3)
 b. Leaves not ending with a tendril. (c)
 c. Pod a loment. (3)
 c. Pod not a loment. (d)
 d. Vines with pinnately compound leaves. (4)
 d. Erect or with palmately 3-foliate leaves. (5)
 1. Herbs, with digitately 8-foliate or simple leaves. **BAPTISIA** I
 1. Trees with pinnate leaves **CLADRASTIS** II
 2. Calyx lobes leafy **PISUM** III
 2. Calyx lobes not leafy. Style flattened **LATHYRUS** IV
 2. Calyx lobes not leafy. Style filiform **VICIA** V
 3. Leaves pinnately 8-foliate. Flowers yellow **STYLOSANTHES** VI
 3. Leaves pinnately 4-foliate. Flowers yellow **ARACHIS** VII
 3. Leaves pinnately 8-foliate. Pod 8 to 7-jointed **DESMODIUM** VIII
 3. Leaves pinnately 8-foliate. Pod 1-seeded **LESPEDeza** IX
 4. Leaves pinnately 5 to 15-foliate. Woody vines **WISTARIA** X
 4. Leaves pinnately 5 to 7-foliate. Herbaceous vines **APIOS** XI
 4. Leaves 3-foliate. Flowers never yellow.
 Keel of corolla twisted **PHASEOLUS** XII
 Keel of corolla not twisted **AMPHICARPÆA** XIII
 5. Leaves palmately 5 to 15, or rarely simple. Herbs No. XX or **LUPINUS** XIV
 5. Leaves palmately 1 to 3-foliate. Low, shrubby plants **CYTISUS** XV
 5. Leaves palmately 3-foliate. Trees or shrubs **LABURNUM** XVI
 5. Leaves palmately, rarely pinnately, 3-foliate. Pods small,
 straight. Flowers in dense heads or spikes **TRIPOLIUM** XVII
 5. Leaves pinnately 3-foliate. Pods spiral or curved **MEDICAGO** XVIII
 5. Leaves pinnately 3-foliate. Flowers white or yellow, in
 slender racemes **MELILOTUS** XIX
 5. Leaves pinnately 3 to 5-foliate; usually dark dotted. Flowers
 never yellow **PSORALEA** XX
 5. Leaves odd-pinnate. Flowers with only one petal. Shrubs **AMORPHA** XXI
 5. Leaves odd-pinnate. Pod 2-celled lengthwise **ASTRAGALUS** XXII
 5. Leaves odd-pinnate. Pod 1-celled. Herbs **TEPHROSIA** XXIII
 5. Leaves odd-pinnate. Pod 1-celled. Trees or shrubs **ROBINIA** XXIV

B. Suborder II. Cæsalpiniceæ

- Leaves simple. Flowers perfect, purple. Trees **CERCIS** XXV
 Leaves pinnate. Flowers perfect, yellow. Herbs **CASSIA** XXVI
 Leaves pinnate or bipinnate. Flowers polygamous. Trees **GLEDITSCHIA** XXVII
 Leaves bipinnate. Flowers dithecous. Trees **GYMNOCLADUS** XXVIII

C. Suborder III. Mimoseæ

- Stamens not more than 10.
 Pods flat, breaking up into 1-seeded joints **MIMOSA** XXIX
 Pods 4-sided, 4-valved, prickly **SCHRANKIA** XXX
 Pods flat, smooth, 2-valved **DESMANTHUS** XXXI
 Stamens more than 10. Monadelphous at the base **ALBIZZIA** XXXII

I. BAPTISIA, VENT. FALSE INDIGO. Erect, perennial herbs, with palmately 3-foliate or sometimes simple leaves, which usually blacken in withering, and yellow, white, or blue flowers in racemes. Calyx bell-shaped, 4 to 5-toothed, persistent. Standard erect, orbicular, with reflexed sides about

as long as the wings and keel. Stamens 10, distinct. Pod stalked, inflated, ovoid, oblong or globose, pointed, with many, or by abortion, few seeds.

Leaves 3-foliolate. Flowers yellow	No. 1
Leaves 3-foliolate. Flowers cream-colored. Stipules large	No. 2
Leaves 3-foliolate. Flowers white	No. 3, 4
Leaves 3-foliolate. Flowers blue	No. 5
Leaves simple. Flowers yellow	No. 6

1. *B. tinctoria*, R. BR. WILD INDIGO. HORSEFLY WEED. A smooth, bushy, somewhat glaucous herb, 2° to 3° high, with bluish-green foliage, common in dry soils from Me. to La. Leaves subsessile; leaflets wedge-obovate, 6'' to 18'' long. Stipules and bracts minute, bristle-like, caducous. Flowers yellow, in loose, terminal racemes. Pod ovoid, 3'' to 5'' long, on a stipe exceeding the calyx, tipped with the style and usually 1-seeded. July to Sept.

2. *B. leucophæa*, Nutt. A low, soft-hairy herb, 1° high, with spreading branches, common in the prairies of Ill., Mich., and Minn. and south to La. and Tex. Leaves sessile or short-stalked, with oblanceolate to obovate leaflets, 2' to 3' long. Stipules and bracts large, leaf-like, triangular-ovate, persistent. Racemes lateral, long, sometimes 1°, with 20 to 50 large, cream-colored flowers 1' long, turned upward on slender pedicels about as long. Pod ovoid, downy or hoary, 1' to 2' long. April, May.

3. *B. leucantha*, Torr. and Gray. A stout, smooth, and glaucous herb, 2° to 5° high, with spreading branches, conspicuous in prairies and rich soils from Ohio to Minn. south to Fla. and La. Leaves petiolate, with wedge-obovate, obtuse leaflets 1' to 2' long, and lanceolate or linear, deciduous stipules about equaling the petioles. Racemes lateral, erect, loose, 6' to 24' long, with large, white flowers 9'' to 10'' long, succeeded by ellipsoid, long-stiped pods. Entire plant becomes bluish-black in withering. May to July.

4. *B. alba*, R. Br. A smooth herb, with widely spreading, slender branches, 1° to 3° high, found in dry soils from N.C. to southern Ind. and Mo. south to Fla. and La. Petioles slender, 3'' to 9'' long; stipules and bracts minute, caducous. Leaflets about 1' long, elliptic-lanceolate. Racemes lateral, erect, 6' to 10' long, on long peduncles. Flowers pure white, about 6'' long, on pedicels about as long. Pod oblong-linear, 12'' to 18'' long. Plant withers without blackening.

5. *B. australis*, R. Br. BLUE FALSE INDIGO. A tall, stout, smooth, and handsome plant, 4° to 6° high, of rich soils from western Pa. to Ga. and west to southern Ind., Mo., and Ark. Leaves short-stalked; leaflets oblanceolate or obovate, obtuse, 12'' to 30'' long. Stipules lanceolate, about equaling the petioles, persistent. Racemes terminal, erect, long, loosely flowered. Flowers indigo-blue, 9'' to 12'' long, on pedicels about 3'' long. Bracts caducous. Pods oblong-oval, about 2' long, on a short stipe. June to Aug.

6. *B. perfoliata*, R. Br. A remarkable, smooth and glaucous species found in dry, sandy soils in S.C. and Ga. Stem branching, 1° to 2° high. Leaves simple, perfoliate, oval or orbicular, about 2' wide, entire, and very thick. Flowers yellow, about 6'' long, solitary, on axillary peduncles. Pods small, ovate, coriaceous. May.

II. *CLADRÁSTIS*, Raf. Trees, with odd-pinnate, exstipulate leaves, and terminal panicles of showy, white flowers.

Calyx bell-shaped, 5-toothed. Standard large, roundish, reflexed. Petals of the keel and wings straight and distinct. Stamens 10, distinct. Pod short-stiped, flat, thin, 4 to 6-seeded. Excepting one of eastern Asia, the species given below is the only one known.

1. *C. tinctoria*, RAF. YELLOWWOOD. AMERICAN OR KENTUCKY Y. A handsome tree, 20° to 40° high, of rich soils and hillsides, native of Ky., Tenn., and western N.C. and cultivated elsewhere for ornament. Bark smooth, resembling that of the beech. Wood yellow, yielding a yellow dye. Leaves smooth, bright green, turning bright yellow in autumn. Leaflets 7 to 11, stalked, oval or ovate, short-acuminate, 2' to 4' long, parallel-veined. Flowers cream-white, fragrant, about 1' long, on slender pedicels in loose, drooping panicles 10' to 20' long. Pod linear, smooth, 2' to 4' long, 2 to 6-seeded. May, June.

III. *PISUM*, L. PEA. Diffuse or climbing annuals, with equally pinnate leaves ending in a branching tendril, and large flowers with leafy calyx lobes. Leaflets 1 to 3 pairs. Standard large, obovate or orbicular. Wings falcate, oblong, longer than and adhering to the keel. Stamens diadelphous, 9 and 1. Style bearded on the inner side, grooved on the back. Pod several-seeded. Seeds globose.

1. *P. sativum*, L. COMMON PEA. A smooth, glaucous, Old World, tendril-climbing plant, cultivated for its edible seeds from time immemorial. Leaflets 2 to 3 pairs, oval or ovate. Stipules leaf-like, usually as large as the leaflets. Flowers 2 or more, on axillary peduncles, white, varying to bluish or party-colored. Var. *arvense*, POIR. (*P. ARVENSE*, L.), the FIELD PEA, cultivated for forage, has usually dull white or bluish flowers, with purple wings and angular seeds. Other varieties are *humile*, the *dwarf pea*; *saccharatum*, the *sugar pea*; *umbellatum*, the *crown pea*; etc.

IV. *LATHYRUS*, L. Annual or perennial, climbing or rarely erect herbs, with pinnate leaves mostly ending in a tendril, leafy, half-sagittate stipules, and showy, papilionaceous flowers, solitary or racemed, on long, axillary peduncles. Calyx obliquely companulate, 5-toothed. Standard large, roundish, notched. Wings falcate, longer than the incurved, obtuse keel. Stamens diadelphous, 9 and 1, or monadelphous below. Style flat, dilated above, curved, hairy along the inner side, next the free stamen. Pod oblong, flat, several-seeded.

Leaflets 3 to 6 pairs. Stipules large and broad	. . . . .	No. 1
Leaflets 4 to 6 pairs. Stipules narrow	. . . . .	No. 2
Leaflets 2 to 4 pairs. Stipules narrow. Stem sometimes winged	. . . . .	No. 3, 4
Leaflets 1 pair. Ornamental exotics	. . . . .	No. 5, 6

1. *L. maritimus*, BIGELOW. BEACH PEA. SEA OR SEASIDE PEA. A stout perennial, with creeping rootstock and decumbent, spreading stem, 1° to 2° high, found on sandy shores from N.J. northward, around the Great Lakes, on the Pacific coast, and in corresponding latitudes around the globe. Stem 4-angled. *Stipules broadly ovate, cordate-hastate, nearly as large as the 6 to 12 thick, ovate-oblong, pale green leaflets 1' to 2' long.* Peduncles a little shorter than the leaves, bearing 6 to 10 purple flowers, 9'' to 12'' long. Pod oblong-linear, 18'' to 3' long, nearly smooth, veined. May to Aug.

2. *L. venosus*, MUHL. SHOWY WILD PEA. A stout, climbing perennial, with smooth or finely pubescent, 4-angled stem, 2° to 3° long, found on shady banks of streams from western N.J. to Ga. west to Kan. and Minn. *Stipules small, semisagittate, narrow, acuminate.* Leaflets 4 to 7 pairs, somewhat alternate, oblong-ovate, obtusish, 1' to 2' long, mucronulate. Peduncles shorter than the leaves, bearing 8 to 16 purple flowers 6'' to 8'' long. Pod smooth, linear, 18'' to 3', veined. June, July.

3. *L. palustris*, L. MARSH PEA. A smooth or somewhat pubescent perennial, with slender, angled, and winged stem, 1° to 3° long, found in wet places from N.J. northward and westward and in corresponding latitudes in Europe and Asia. *Stipules small, semisagittate, lanceolate.* Leaflets 2 to 4 pairs, narrowly oblong-ovate or lanceolate to linear, 1' to 2' long, mucronulate. Peduncles about as long as the leaves, bearing 2 to 6 purple flowers, about 6'' long. Pod linear, 18'' to 30'' long, smooth or somewhat pubescent. May to Aug.

4. *L. myrtifolius*, MUHL. MYRTLE-LEAVED MARSH PEA. A smooth perennial, of the same range as the preceding and south to N.C., differing from it mainly in having its stem angled but *not winged, smaller ovate, obtuse leaflets, broader and larger stipules and pale purple flowers.* May to July.

5. *L. odoratus*, L. SWEET PEA. An ornamental annual from Sicily, with rough, hairy, winged, climbing stem, 3° to 4° high, lanceolate stipules, and leaves of but one pair of oval or oblong mucronulate leaflets. Flowers 2 to 4, on peduncles much longer than the leaves, large, white with pink or purple standard varied indefinitely in shades of color and very fragrant. Pod 1' to 2' long. June.

6. *L. latifolius*, L. EVERLASTING OR PERENNIAL PEA. A smooth, hardy, ornamental perennial from England, with climbing, broadly winged stem, 6° to 8° long, broad-ovate stipules, and leaves of but one pair of ovate-lanceolate, rather glaucous leaflets 2' to 3' long. Peduncles longer than the leaves, bearing many large, pink-purple, scentless flowers. Pods flat, 4' to 5' long. Aug.

V. *VÍCIA*, L. VETCH. TARE. Climbing or trailing, annual or perennial herbs, with pinnate leaves ending in a tendril, semisagittate or entire stipules, and blue or violet, sometimes yellowish or white, racemed or sessile, axillary flowers. Calyx tubular, 5-toothed. Standard obovate or oblong, emarginate; wings adherent to the curved keel. Stamens diadelphous, 9 and 1, or monadelphous below. Style very slender, bearded at the summit beneath the stigma, either all around or only on the back. Pod flat, several-seeded. Seeds globose.

Leaflets 8 to 24.	Peduncles 4 to 8-flowered	. . . . .	No. 1
Leaflets 8 to 24.	Peduncles many-flowered, small	. . . . .	No. 2, 3
Leaflets 8 to 24.	Flowers few, large	. . . . .	No. 4

1. *V. Americana*, MUHL. A smooth, slender, trailing or climbing perennial, 2° to 3° long, of moist grounds from New Eng. to Va. west to Minn. and Kan. Stipules broad-ovate, deeply dentate. Leaflets 10 to 14, subsessile, elliptic-ovate or lanceolate, obtuse, mucronate, veined, somewhat alternate, 8" to 16" long. Flowers 8" long, blue or purple, in loose racemes of 4 to 8, on peduncles shorter than the leaves. Var. *linearis*, WATSON, with weak, often zigzag stems, 1° to 2° long, and linear leaflets, occurs in dry soils in Kan., Neb., and westward. May to Aug.

2. *V. Caroliniana*, WALT. A slender, smooth or smoothish, trailing or climbing perennial, 2° to 6° long, of river banks and open woods from N.Y. to Minn. south to Kan., Ky., and Ga. Leaves on short petioles. Stipules oblong or linear, entire. Leaflets 8 to 16, linear-oblong, 6" to 12" long, mostly alternate. Flowers 3" to 5" long, whitish with bluish-tipped keel, 8 to 20 in a loose raceme, on peduncles about as long as the leaves. Pods smooth, 10" to 12" long. May to July.

3. *V. Cracca*, L. TUFTED VETCH. Cow V. BLUE V. A downy-pubescent, trailing or climbing perennial, found along hedges, fences, and thickets from Me. to Minn. south to N.J. and Ky., also in the Old World. Stems tufted, square, slender, weak, 2° to 4° long. Stipules linear, subulate, entire. Leaflets 18 to 24, oblong or linear-oblong, mucronate, 8" to 10" long. Flowers blue and purple, 5" to 6" long, reflexed, 12 to 20, in dense, one-sided, spike-like racemes, on axillary peduncles about as long as the leaves. Pods smooth, 9" to 12" long. June to Aug.

4. *V. sativa*, L. COMMON VETCH OR TARE. A slender, climbing annual, found in cultivated fields and waste places from New Eng. to Minn. south to Fla. and Tex., introduced from Europe, where it is cultivated for fodder. Stem somewhat pubescent, decumbent or climbing, 1° to 3° long. Leaflets 10 to 12, oblong-ovate to linear, retuse, mucronate, 10" to 15" long. Flowers bluish-purple, 10" to 12" long, *solitary or in pairs*, axillary, sessile or short-stalked. Pod smooth, linear, 1' to 2' long, 5 to 10-seeded. June. Var. *angustifolia*, SERRÆX, near the coast, has narrow and longer leaflets.

VI. *STYLOSANTHES*, SWARTZ. Low, perennial herbs, with pinnately 3-foliate leaves, sheath-like stipules, and yellow flowers in terminal or axillary, leafy-bracted heads or short spikes. Calyx 2-bracted, with a slender, stalk-like tube, an unequally 4 to 5-cleft limb, and the corolla and monadelphous stamens inserted in its throat; the whole falling off early so that the ovary ripens naked. Anthers 10, shorter and longer alternately. Standard orbicular. Style slender, losing its upper part after flowering, while the lower part forms a persistent hooked point on the small, reticulated, 1 to 2-jointed, but by abortion of the lower joint, 1-seeded pod.

1. *S. elatior*, SWARTZ. PENCIL FLOWER. A tufted herb, with wiry, branching stems, 6' to 18' high, found in dry soils and gravelly woods from southern N.Y. to Fla. west to southern Ind., Ky., Kan., and La. Leaves short-stalked. Leaflets lanceolate, straight-veined, 10" to 15" long. Flowers few, 3" to 4" long, mostly in terminal spikes. Bracts fringed with yellow. Loment obovate, pubescent, about 2" long. July, Aug.

VII. *ARACHIS*, WILLD. South American annuals, with equally pinnate leaves, and small, yellow flowers in axillary

spikes or heads. Calyx with a long, slender tube and a bilabiate limb. Corolla inverted. Stamens monadelphous. Anthers alternately longer and shorter, as in *Stylosanthes*. Pod gibbous at base, oblong, turgid, coriaceous, reticulated, indehiscent, 1 to 3-seeded.

1. *A. hypogæa*, WILLD. PEANUT. GROUNDNUT. A procumbent, nearly smooth annual, with 2 pairs of oval or roundish leaflets, cultivated in N.C. and other Southern States for its edible seeds. Flowers 5 to 7. The ovary after flowering is thrust into the soil by the elongating stipe and there ripened, whence its specific name "*hypogæa*" (underground) and one of its common names "groundnut." May.

VIII. DESMÓDIUM, DC. TICK TREFOIL. Erect, ascending or prostrate, perennial herbs, sometimes shrubby at the base, with pinnately 3-foliate, rarely 1-foliate, stipulate and stipellate leaves, and mostly small, purple, or purplish flowers in axillary or terminal racemes or panicles. Calyx 5-toothed, usually more or less 2-lipped. Standard roundish; keel obtuse. Stamens diadelphous, 9 and 1, sometimes monadelphous below. Pod a loment, sessile or stalked, flat, several-jointed, constricted most, sometimes only, on the lower or dorsal suture, the joints 1-seeded, indehiscent, separable, reticulated, and usually roughened with minute, hooked hairs by which they cling to clothing or to the wool or hair of animals.

Exotic species	No. 9
Native species.	
Loment constricted only below. Pod long-stiped	Nos. 1, 2
Loment constricted also above. Pod not long-stiped. (a)	
a. Stem trailing	No. 3
a. Stem erect or ascending. (b)	
b. Stipules large, 6'' to 9'' long, ovate-lanceolate. (c)	
b. Stipules small, awl-shaped. (d)	
c. Stems hairy. Leaflets ovate, blunt.	No. 4
c. Stems smooth. Leaflets ovate-lanceolate, acuminate	No. 5
d. Joints of pods triangular	Nos. 6, 7
d. Joints of pods roundish	No. 8

1. *D. nudiflorum*, DC. NAKED-FLOWERED T. T. A common herb, of dry woods from New Eng. to Minn. south to Fla and La., with an erect or ascending, slender stem, 8' to 10' high, terminating in several ternate, long-petioled, rather smooth leaves, and a smooth, slender, ascending, usually leafless scape 2° to 4° long, bearing a raceme or panicle of many small, purple flowers, each 3'' to 5'' long. Leaflets roundish-ovate, somewhat acuminate, blunt-pointed, whitish beneath. Loment, on a stipe nearly as long as the pedicel and many times longer than the calyx, with 2 to 4 obtusely triangular joints pubescent with hooked hairs. Stamens monadelphous below. Stipules bristle-like, deciduous. July, Aug.

2. *D. acuminatum*, DC. POINTED-LEAVED T. T. A smooth or slightly pubescent, erect herb, of rich woods and the same range as No. 1. Stem 1° to 2° high, with the leaves clustered at the top, from which arises a

slender, long-peduncled, many-flowered, terminal raceme or panicle 1° to 2° long. Petioles 3' to 6' long. Stipules awl-shaped, usually persistent. Leaflets round-ovate, *acuminate*, green on both sides, terminal one roundish, 3' across, lateral ones smaller, *all of them conspicuously pointed*. Flowers purple. Loment as long-stiped as in No. 1, with 2 to 3 hooked-pubescent joints. July, Aug.

3. *D. rotundifolium*, DC. ROUND-LEAVED T. T. A trailing, hairy plant, 2° to 6° long, of dry, rocky or open woods from Me. to Minn. south to Fla. and La. Leaves petioled. Stipules conspicuous, triangular-ovate, *acuminate*, persistent. Leaflets orbicular or nearly so, 1' to 2' long, hairy on both sides. Flowers few, purple, in loose axillary or terminal panicles. Loment on a short stipe little exceeding the calyx, constricted almost equally on both sides; joints 3 to 5, obliquely rhomboid-oval. July to Sept.

4. *D. canescens*, DC. HOARY T. T. An erect, loosely branched, densely hairy herb, 3° to 5° high, common in rich soils and low, moist woods from Vt. and Mass. to Minn. south to Fla. and La. Leaves petioled. Stipules large, ovate-lanceolate, *acuminate*, persistent. Leaflets ovate, obtuse, about as long as the petiole, rough above, soft-villous beneath. Flowers greenish without, purple within, in a very long, terminal, densely canescent panicle. Loment short-stiped as in No. 3, with 4 to 7 obliquely oval, very adhesive joints. July, Aug.

5. *D. cuspidatum*, TORR AND GRAY. An erect, branching herb, 4° to 5° high, smooth except in its panicle, found in thickets and woods from N.Y. to Minn. south to Fla. and Tex. Stem straight. Stipules and bracts conspicuous, lanceolate, awl-shaped, *cuspidate*; the former usually persistent, the latter deciduous. Leaflets oblong-ovate or ovate-lanceolate, *acuminate*, 2' to 5' long, green on both sides. Flowers purple, about 8" long. Loment pendulous, of 3 to 7 obliquely oblong, hooked-pubescent joints, on a short stipe about equal to the calyx lobes. Aug., Sept.

6. *D. Dillenii*, DARL. DILLEN'S T. T. An erect, branching, hairy plant, 2° to 5° high, common in woodlands from Me. to Minn. south to Va., Ky., Mo., and Tex. Stem rough, grooved. Stipules and bracts small, inconspicuous, and mostly deciduous. Leaflets oblong or oblong-ovate, 2' to 3' long, pale and softly pubescent beneath. Flowers purple, in a large, terminal, naked panicle. Loment on a very short stipe, with 2 to 4 nearly triangular, hooked-pubescent joints. June to Sept.

7. *D. paniculatum*, DC. A slender, erect, nearly smooth plant, 2° to 4° high, common in woods from Me. to Minn. south to Fla. and Tex. Stem striate. Stipules awl-shaped, deciduous. Leaflets oblong-lanceolate or linear-lanceolate, obtuse, 1' to 3' long. Flowers purple, on slender pedicels 4" to 5" long, in *panicled racemes*. Loment on a very short stipe, with 3 to 5 triangular joints. July to Sept.

8. *D. Canadense*, DC. SHOWY T. T. A stout, erect, downy plant, 4° to 6° high, common in thickets and on river banks from Me. to Dak. south to N.C. and Mo., and the most showy species in its range. Stem striate, hairy. Stipules linear-lanceolate. Lower leaves on petioles 6" to 12" long, upper ones nearly sessile. Leaflets oblong-lanceolate, obtuse, nearly smooth. Flowers pink-purple, 6" to 8" long, in dense, terminal racemes. Loment nearly sessile, of 3 to 5 obtusely triangular, hooked-pubescent joints. July to Sept.

9. *D. gyrans*, DC. TELEGRAPH PLANT. An East Indian plant, 2° to 3° high, normally a perennial, but in cultivation an annual, remarkable for the singular movements of its leaflets. The terminal one, oblong-elliptic, 6 times as long as the nearly linear lateral ones, droops in the evening and rises again in the morning with no other movement; while the two diminutive lateral ones in a suitably high temperature have a

continual jerking movement upward and downward, day and night, with only an occasional cessation as if from exhaustion. Flowers purple or violet, in a panicle.

IX. LESPEDEZA, Mx. BUSH CLOVER. Mostly perennial herbs or shrubs, with pinnately 3-foliate leaves, small stipules, no stipels, and small purple or whitish, often incomplete and polygamous flowers in axillary spikes, heads, or other clusters. When incomplete flowers occur, the petaliferous are usually sterile and the apetalous fertile. Calyx 5-cleft, 2-bracted. Standard obovate or oblong; keel obtuse. Stamens diadelphous, 9 and 1; anthers all alike. Pod a small, indehiscent, unarmed, oval or roundish, flat, 1-seeded joint, or sometimes with 2 joints, the lower one empty and stalk-like.

- a. Perennials. Stipules and bracts minute and awl-shaped. (b)
 a. An annual. Stipules and bracts conspicuous No. 6
 b. All the flowers complete. Calyx long. Petals whitish Nos. 1, 2
 b. Some of the flowers apetalous. Calyx short. Petals violet. (c)
 c. Stems erect Nos. 3, 4
 c. Stems trailing No. 5

1. *L. capitata*, Mx. **ROUND-HEADED B. C.** A stiff, hairy, half-shrubby perennial, of dry soils from Me. to Minn. and Neb. south to Fla. and La. Stem erect or ascending, woolly, nearly simple and wand-like, 2° to 4° high. Leaves numerous, nearly sessile. Leaflets narrowly oblong, leathery, smooth above, silky or downy beneath. Flowers cream-colored with a purple spot on the standard, in oblong-globose heads on peduncles shorter than the leaves. Pod oblong-ovate, hairy, shorter than the calyx. Aug., Sept.

2. *L. hirta*, ELL. **HAIRY B. C.** A very hairy, branching perennial, of the same range and habitat as No. 1, and similar to it in having its flowers complete, perfect, etc. It differs mainly in having the leaves petioled, the leaflets roundish, nearly orbicular, the peduncles elongated, often longer than the leaves, the flower spikes cylindrical, and the pods about as long as the calyx. Aug. to Oct.

3. *L. violacea*, PERS. A perennial, of the same range and habitat as Nos. 1 and 2, with slender, erect or spreading, branched, sparingly pubescent stems, 1° to 3° high. Leaflets thin, oval to oblong and linear, obtuse, mucronate, about as long as the petioles. The larger, complete, and perfect, but rarely fruitful flowers violet-purple; the smaller fertile ones apetalous. Peduncles slender, usually longer than the leaves, bearing loosely flowered panicles. Flowers 3'' to 4'' long. Pod ovate, 2'' to 3'' long, nearly smooth, much longer than the calyx. Aug., Sept.

4. *L. reticulata*, PERS. An erect, simple or branched, very leafy perennial, of dry soils from Mass. to Minn. south to Fla. and Tex. Leaflets linear to oblong or elliptic, obtuse, 6'' to 15'' long, smooth and dark green above, paler and appressed-pubescent beneath. Flowers as in No. 3, but smaller, 2'' to 3'' long, and in short-stalked axillary clusters, usually crowded toward the top of the stem. Pod ovate, acute, about 2'' long, much exserted from the calyx. Aug., Sept.

5. *L. procumbens*, Mx. **TRAILING B. C.** A slender, trailing perennial, common in dry soils from Mass. to Kan. south to Fla. and La. Stems prostrate or sometimes ascending, diffuse, 12' to 80' long. Petioles

shorter than the leaves. Leaflets oval or obovate-elliptical, obtuse or retuse, 6" to 12" long. Peduncles slender, simple, axillary, longer than the leaves. Flowers few, nearly sessile, complete and incomplete, the former violet-purple or pink-purple; the latter or sometimes all apetalous. Pod small, oval or roundish. Aug., Sept.

6. *L. striata*, Hook. and Arn. JAPAN CLOVER. A slender, erect or decumbent annual from Japan and China, introduced as a forage plant in the Southern States and now extensively naturalized south of the Potomac and the Ohio. Stem low, spreading, 6' to 12' high, nearly smooth, branched. Leaves small, very numerous, on short petioles. Stipules ovate, acute, or acuminate. Leaflets oblong or obovate, 5" to 9" long. Flowers small, pink or purple, petaliferous and apetalous together, in nearly sessile, axillary clusters of 1 to 5. Pods oval, acute, small, but longer than the calyx. July, Aug.

X. WISTARIA, Nutt. High-climbing, twining shrubs, with minute stipules, odd-pinnate leaves, and showy, terminal racemes of blue or purplish flowers. Racemes large, with large, colored bracts. Calyx somewhat 2-lipped, the 3 lower teeth rather larger than the 2 upper. Standard large, reflexed with 2 callosities on the claw; wings and keel scythe-shaped, the former auricled at the base. Stamens diadelphous. Pods elongated, stipitate, many-seeded, torulose, at length 2-valved. Seeds large, kidney-shaped.

1. *W. frutescens*, DC. AMERICAN W. A vigorous, woody vine, often 30° to 40° long and several inches in diameter, climbing over bushes and trees in low grounds from Va. to Kan. south to Fla. and La. *Racemes densely flowered*. Leaves petioled. Leaflets 9 to 13, ovate or ovate-lanceolate, acute, *smooth and dark green above, pale beneath. Wings with one short and one long and slender auricle at the base*. Pod linear, 2' to 3' long. Often cultivated for ornament. April to June.

2. *W. chinensis*, DC. (*W. consequana*, Benth.) CHINESE W. An ornamental, hardy, fast-growing climber from China, with *pale-green foliage and long-drooping loosely flowered racemes* of purplish flowers. Leaflets 9 to 13, ovate-lanceolate, in opposite distant pairs, *silky-pubescent on both sides*. Wings with but one auricle each. May, June.

XI. APIOS, Boerhaave. Smooth, twining, perennial herbs, with subterranean shoots, usually tuberous, pinnately 3 to 7-foliolate leaves, and brownish-purple flowers in short, dense racemes on axillary peduncles. Calyx somewhat 2-lipped, the 2 upper teeth very short and blunt, the 2 side teeth nearly obsolete or wanting, and the lower one long and acute. Standard very broad, reflexed. Stamens diadelphous, 9 and 1. Pod nearly terete, many-seeded.

1. *A. tuberosa*, Moench. GROUNDNUT. WILD BEAN. A slender, rather smooth, twining perennial, 4° to 8° long, climbing over bushes in low, moist grounds from Me. to Minn. south to Fla. and La. Leaves numerous, petiolate. Leaflets 5 to 7, mostly 7 (rarely 3), ovate-lanceolate, short-stalked, 1' to 3' long. Flowers chocolate-colored, fragrant. Pods

linear, straight or curved. Tubers oval or pear-shaped, 1' to 2' long, edible, nutritious. July, Aug.

XII. PHASEOLUS, L. Annual or perennial, mostly twining or trailing herbs, with usually pinnately 3-foliate, stipulate leaves, stipellate leaflets, and white, yellow, red, or purplish flowers in racemes above the middle or in clusters at the ends of the axillary peduncles. Calyx 5-toothed, the 2 upper teeth more or less united. Keel with the included diadelphous (9 and 1) stamens and style spirally coiled or twisted. Style bearded along the upper or inner side. Stigma lateral or oblique, not capitate. Pods more or less flattened and falcate, 2-valved, with few or many seeds, and tipped with the base of the style.

Native species.	Flowers in racemes.	Pods curved	No. 1
Native species.	Flowers in heads.	Pods straight	No. 2
Exotic species.	Stems twining		Nos. 3, 4, 5
Exotic species.	Stems erect		No. 6

1. *P. perennis*, WALT. **WILD BEAN VINE.** A slender, finely pubescent, somewhat branching, twining, perennial herb, 4° to 10° long, climbing over bushes or trailing, common in dry woods from New Eng. to Minn. and Neb. south to Fla. and La. Leaflets broadly ovate, 1' to 3' long. Racemes, sometimes 2 or 3 together, loose, 6' to 12' long. Pedicels 2'' to 4'' long, with bracts at the base. Flowers purple, 3'' to 4'' long. Pods stipitate, drooping, slightly curved, flat, about 2' long, with 4 to 6 rather smooth, chocolate-colored seeds. July to Sept.

2. *P. helvolus*, L. A perennial herb, with slender, trailing, branching, smooth or hairy stems from 2° to 5° long, found in sandy soils from N.Y. to Ind. south to Fla. and La. Leaflets ovate to lance-ovate, not lobed, 1' to 2' long. Peduncles slender, few-flowered, much longer than the leaves. Flowers pink or purplish, 6'' long, sessile, in umbellate heads. Calyx 2-bracted. Standard large, roundish. Pod 1' to 2' long, linear, straight, nearly terete. July to Sept.

3. *P. vulgaris*, L. **COMMON BEAN. KIDNEY B.** A smoothish, twining annual, 3° to 8° long, of uncertain origin, now believed to be from tropical America, long cultivated for food. Leaflets ovate-acuminate. Racemes solitary, shorter than the leaves. Flowers small, usually white or lilac. Pods pendulous, slender, slightly curved, with a straight or curved tip. July.

4. *P. multiflorus*, L. **SCARLET POLE BEAN. SCARLET RUNNER. SPANISH B.** A South American and Mexican perennial, cultivated as an annual in temperate regions, with a slender, twining, minutely pubescent stem rising 8° to 10°. Leaflets ovate or rhombic-ovate, acute, thin, rough-pubescent. Racemes solitary, as long as the leaves. Flowers scarlet, very many. Pods 3' to 6' long, pendulous. Seeds red and black. Cultivated for ornament and known sometimes as *Flowering Bean* or *Painted Lady*. A variety with white flowers and white seeds is cultivated in the vegetable garden and known as the *Dutch Case-knife Bean*. July.

5. *P. lunatus*, L. **SIEVA OR CIVET BEAN. LIMA B. BUTTER B.** A slender South American twiner, with thin, triangular-ovate leaflets, small, greenish-white flowers, small, papery pods 2' to 3' long, with curved back and long tip, opening when ripe with twisting valves. Beans small,

flat, and white, brown, or mottled. Var. *macrocarpa*, BENTH., is the **LIMA BEAN**, distinguished from the type by its taller and more robust growth, later ripening, and its larger and thicker ovate-lanceolate leaves. Its pods also are nearly or entirely straight, without conspicuous tip, and do not split when ripe. Beans very large, usually white. A smaller-seeded Lima bean with a shorter and thicker pod is known as *Potato Lima* or *Butter Bean*.

6. *P. nanus*, L. **BUSH B.** A widely cultivated annual, resembling the common or kidney bean above, No. 3, and by some regarded as merely a variety. Stem smooth, erect, branching, bushy, about 1° high, with broad-ovate, acute leaflets. Flowers white. Pods compressed, pendulous, wrinkled. Seeds small, white, varying much in cultivation. June.

XIII. AMPHICARPEA, ELL. Low perennial or annual (?) vines, with slender, twining stems, pinnately 3-foliolate leaves, and small white or purplish flowers in simple or compound axillary racemes. Leaflets stipellate. Flowers of 2 kinds; upper ones complete and perfect, but rarely maturing fruit; the lower ones solitary in the lower axils or on thread-like, creeping branches, apetalous and fruitful. Calyx 4 to 5-toothed. Standard obovate, erect, partly folded around the wings and keel. Stamens diadelphous or in the fertile flowers distinct or wanting. Style beardless, filiform, capitate. Pods of the complete flowers, when produced, linear-oblong, stipitate, several-seeded; of the lower or fertile flowers obovoid, often subterranean and 1-seeded.

1. *A. monoica*, NUTT. **HOG PEANUT.** A very slender vine, common in rich, damp thickets and woodlands from Me. to Neb. south to Fla. and La. Stem simple or somewhat branching, 4° to 8° long, retrorsely pubescent. Leaflets thin, broadly ovate, acute, 1' to 3' long; lateral ones with oblique base. Stipules ovate or oblong. Racemes simple, few-flowered, pendulous. Aug., Sept.

2. *A. Pitcheri*, TORR. AND GRAY. A stouter vine than No. 1, of similar habitat, with a range from western N.Y. to Mo., La., and Tex. Stem villous with reflexed brown hairs. Leaflets larger and thicker than in No. 1, often 4' long, rhombic-ovate, hirsute on both sides. Aug., Sept.

XIV. LUPINUS, TOURN. **LUPINE.** Herbs, rarely shrubs, with palmately 5 to 15-foliolate, rarely simple leaves, and showy flowers in terminal racemes or spikes. Stipules adnate to the base of the petioles. Calyx 2-lipped; upper lip 2-cleft; lower 3-toothed or entire. Standard roundish, its sides reflexed. Keel falcate, acute. Stamens monadelphous, anthers alternately globous and oblong. Pods coriaceous, compressed, oblong, often constricted between the seeds.

1. *L. perennis*, L. **WILD LUPINE.** An erect perennial, common in sandy soils from Me. to Minn. south to Fla. and La. Stem soft, smoothish, 1° to 2° high. Leaves soft-downy on long petioles. Leaflets 7 to 11,

oblongeolate, mucronate, 12'' to 18'' long. Flowers purplish-blue, varying to pink and white, 6'' to 9'' long, in a rather loosely flowered, peduncled raceme 6' to 10' long. Pods very hairy, broad, 18'' long, 4 to 6-seeded. May, June.

2. *L. villosus*, WILLD. A showy biennial, of the pine barrens from N.C. to Fla., with simple leaves and densely clothed in hoary, silky wool. Stems thick, prostrate or ascending, 1° to 2° high. Leaves mostly at the base, elliptic-oblong, 3' to 5' long, mostly acute, long-petioled. Stipules linear-subulate. Racemes erect, densely flowered, with 50 to 100 large roseate flowers with a dark purple spot at the base of the standard. Pods oblong, very woolly, 4 to 5-seeded. April.

XV. CÝTISUS, TOURN. Low shrubs or rarely trees, of the Old World, with stiff, green, sometimes almost leafless branches, palmately 1- to 3-foliolate leaves, and yellow, white, or purple flowers in the axils or in terminal heads or racemes. Calyx 2-lipped. Standard ovate or roundish. Stamens monadelphous, anthers larger and smaller alternately. Pods flat, linear or oblong, several-seeded.

1. *C. scoparius*, LINK. SCOTCH BROOM. A smooth, stiff, erect, European shrub, 3° to 5° high, with tough, green, angled, wiry branches and large golden-yellow flowers, naturalized in waste places from Mass. to Del. and Va. Lower leaves petiolate, with 3 obovate, acute or mucronate, entire leaflets 3'' to 5'' long, upper ones of a single, sessile leaflet. Flowers usually solitary, on slender pedicels in the axils. In cultivation varieties occur with double and yellowish-white flowers and also with pendulous branches. May, June.

2. *C. Canariensis*, L. A much-branched, hairy, greenhouse shrub from the Canaries, 4° to 6° high, with short-petioled, 3-foliolate, persistent leaves, obovate-oblong, acute leaflets 3'' to 6'' long, and bright yellow, fragrant flowers in elongated, many-flowered, second racemes. Blooms in late winter in conservatories. May to July.

XVI. LABURNUM, BENTH. Ornamental, Old World shrubs or small trees, with palmately 3-foliolate, petioled, exstipulate leaves, and yellow flowers in many-flowered, terminal racemes. Calyx 2-lipped; upper lip with 2 short teeth, lower with 3. Standard ovate, erect. Wings straight. Stamens diadelphous, 9 and 1. Pods linear, compressed, several-seeded, tardily dehiscent. Only one species beside the two here given, and all are said to be poisonous in all their parts, especially the young fruits.

1. *L. vulgare*, GRIS. COMMON LABURNUM. GOLDEN CHAIN. BEAN TREE. A small tree, 15° to 20° high, from southern Europe, with smooth, greenish bark and erect or spreading branches. Branchlets, pedicels, and calyxes appressed-pubescent. Leaves long-petioled. Leaflets ovate-lanceolate, pubescent beneath, 1' to 2' long. Racemes simple, pendulous, 4' to 8' long. Flowers golden-yellow, 8'' to 9'' long. Pods appressed-pubescent, 2' long, with upper suture keeled but not winged. Seeds black. Many cultivated varieties occur; as, *aureum*, with yellow leaves; *involutum*, with curled leaves; etc. May, June.

2. *L. alpinum*, GRIS. SCOTCH LABURNUM. A larger and hardier tree than No. 1, 25° to 30° high, from the mts. of southern Europe and blooming about a fortnight later. Branchlets smooth. Leaflets elliptic, acute, smooth beneath. Racemes long, slender, *pendent*. Flowers smaller than in No. 1. Pods with upper suture winged. Seeds brown. June.

XVII. TRIFOLIUM, L. CLOVER. TREFOIL. Low herbs, with mostly palmately 3-foliolate leaves, usually toothed leaflets, and red, purple, pink, white or whitish, rarely yellow flowers in dense heads or spikes. Stipules adnate to the petiole. Calyx persistent, with 5 bristle-like teeth. Petals usually persistent, withering, all except the standard more or less united with the base of the stamen tube. Standard oblong or ovate; wings narrow; keel shorter than the wings. Stamens diadelphous, 9 and 1, or monadelphous below. Pod membranous, often included in the calyx, indehiscent or opening tardily by only 1 suture. Seeds roundish, 1 to 6.

§ Flowers yellow. (a)

§ Flowers red, crimson, pink, purple, white or whitish. (b)

- | | |
|--|------------|
| a. Heads 6' to 10'' long. Stipules narrow. Leaflets sessile | No. 1 |
| a. Heads 8'' to 6'' long. Stipules ovate. End leaflet stalked | No. 2 |
| b. Heads or spikes oblong or cylindrical. Calyx silky, with plumose teeth. (c) | |
| b. Heads more or less globose. Calyx nearly smooth. (d) | |
| c. Corollas crimson, conspicuous | No. 3 |
| c. Cor. whitish, inconspicuous; grayish, plumose calyx teeth very conspicuous | No. 4 |
| d. Flowers sessile in sessile or leaf-encircled heads | No. 5 |
| d. Flowers sessile in distinct, peduncled heads | No. 6 |
| d. Flowers pediceled, finally reflexed, in peduncled, globose heads. (e) | |
| e. Heads large, 1' or more in diameter, on peduncles 1' to 8' long | Nos. 7, 8 |
| e. Heads smaller, 6'' to 9'' in diameter, on peduncles 2' to 9' long. (f) | |
| f. Stems ascending or procumbent | Nos. 9, 10 |
| f. Stems creeping | No. 11 |

1. *T. agrarium*, L. YELLOW OR HOP CLOVER. A European annual, naturalized in fields and open woods and along roadsides from New Eng. to Va. and western N.Y. Stem *smooth, erect, or ascending*, 6' or 12' high. Leaves petiolate. Stipules *linear-lanceolate, cohering with the petiole more than half its length*. Leaflets *all sessile or nearly so, oblong-ovate, finely denticulate*, 6'' to 8'' long. Flowers yellow, on short pedicels in oblong or oval heads 6'' to 8'' long, reflexed and brown when old. Peduncles axillary, about 1' long. May to Sept.

2. *T. procumbens*, L. LOW OR SMALLER, YELLOW OR HOP C. A European annual, similar to No. 1, but more widely naturalized, extending farther south and west and much more common. Stems *pubescent, spreading or ascending*, 3' to 10' long. Stipules *ovate, much shorter than the petioles*. Leaflets *wedge-obovate, roundish, truncate or notched at the apex, finely denticulate*, 3'' to 7'' long; *the terminal one distinctly stalked*. Flowers on peduncles about 1' long, much as in No. 1, but in smaller, more rounded heads 3'' to 5'' in diameter. Var. *minus*, GRAY, with smaller and fewer-flowered heads, made by some a distinct species (*T. minus*, SMITH *T. dubium*, SIBTH.), is said by some to be the true Shamrock; concerning which compare No. 11, *Wood Sorrel and Black Medic*.

3. *T. incarnatum*, L. CRIMSON OR SCARLET C. ITALIAN C. An erect annual from southern Europe, occasionally cultivated ornamentally

for borders, or agriculturally for fodder or green manuring, and somewhat naturalized in southern N.Y., N.J., and Pa. Stem hairy, erect, 1° to 2° high. Leaves petioled. Stipules broad, membranous. Leaflets obovate-orbicular or obcordate, sessile, denticulate, 6" to 12" long. Flowers crimson or scarlet, rarely cream-colored, 4" to 6" long, sessile, in dense, oblong or cylindrical, obtuse, terminal, pedunculate spikes. June to Sept.

4. *T. arvensis*, L. RABBIT FOOT C. HARE'S FOOT C. STONE C. PESSY C. An Old World, silky-pubescent annual, naturalized in dry, sandy fields and waste places from New Eng. to Fla. and westward. Stems erect, branching, round, 6' to 12' high. Leaves short-petioled. Leaflets oblanceolate or linear, 6" to 12" long. Heads terminal, cylindrical, 1' long, very hairy, soft and downy in consequence of the fine, silky, reddish hairs which densely fringe the slender, equal calyx teeth and project much beyond the white or pale red corollas. July, Aug.

5. *T. pratense*, L. RED, PURPLE, OR MEADOW C. The well-known European perennial so widely introduced and cultivated for pasturage, hay, etc. Stems somewhat hairy, decumbent, ascending or erect, 6' to 2° high. Leaves petioled. Stipules ovate, strongly veined, bristle-tipped. Leaflets oval, oblong, or ovate, with a pale spot in the center, entire, and nearly smooth, 6" to 2' long. Heads sessile, globose or ovoid, about 1' long. Flowers red, rarely white, sweet-scented, sessile, not reflexed when old. April to Nov.

6. *T. medium*, L. ZIGZAG OR MAMMOTH C. A European perennial, naturalized in fields and waste grounds from Me. to N.Y. and westward and also cultivated. Similar to No. 5, but with the stem pubescent or smoothish and usually zigzag, though often straight, the stipules lanceolate, leaflets lanceolate and spotless, heads larger and usually peduncled, and the flowers a deeper color, bright purple. June to Sept.

7. *T. reflexum*, L. BUFFALO C. An annual or biennial, of meadows, pastures, and prairies from western N.Y. and Pa. to Neb. and south to Fla. and Tex. Stems pubescent, ascending or procumbent, branching, 8' to 16' high. Leaves petioled. Stipules leafy, 8" to 12", ovate-lanceolate, acuminate. Leaflets obovate-oblong, denticulate, 6" to 12". Heads globose, densely flowered, on peduncles 1' to 3' long, large, 1' or more in diameter, and handsome. Flowers 5" to 6" long, on slender pedicels, finally reflexed. Standard rose-red; wings and keel nearly white. Pods 3 to 5-seeded. April to Aug.

8. *T. stoloniferum*, MUHL. RUNNING BUFFALO C. A perennial, of fields, prairies, and dry woods from Ohio to Neb. south to Ky. and Mo., very similar to the preceding, but smooth throughout, with creeping stems 6' to 12' long, and short, ascending, axillary branches 3' to 4' high. Leaflets roundish or broadly obcordate, denticulate, 6" to 10" long. Flowers erect, white, purplish-tinged, reflexed in fruit. Heads nearly as in No. 7. Pods usually 2-seeded. May to Aug.

9. *T. Carolinianum*, Mx. CAROLINA C. A tufted, pubescent perennial, of fields and pastures from Va. to Fla. and Tex. Stems prostrate or ascending, slender, diffuse, 6' to 10' long. Stipules ovate-lanceolate, leafy, 2" to 4" long. Leaflets wedge-obovate, 2" to 6" long, denticulate, terminal one obcordate. Heads roundish, long-peduncled. Flowers white, purplish-tinged, reflexed in fruit. Corolla scarcely exceeding the calyx with its long, awl-shaped teeth. Pod usually 4-seeded. March to Oct.

10. *T. hybridum*, L. ALSIKE C. ALSATIAN OR SWEDISH C. A European perennial, sometimes cultivated for fodder and somewhat naturalized from New Eng. to Neb. south to N.J. and Ga. Stems smooth, ascending or erect, 1° to 2° high. Leaves long-petioled. Stipules ovate-lanceolate, membranous, 5" to 10" long. Leaflets obovate, serrulate, 5" to 10'

long. Heads small, loose, globose, long-peduncled. Flowers pink or nearly white, about 4" long, reflexed when old. Corolla 3 times as long as the calyx. Pod 2 to 4-seeded. May to Oct.

11. *T. repens*, L. WHITE C. A low, smooth perennial, with diffuse, creeping stems and branches, naturalized from Europe and common in all soils and regions included in this Flora, and possibly indigenous in the extreme northern ones. Stems 4' to 12' long, often rooting at the joints. Leaves on long petioles. Stipules small, narrow, acute, scarious. Leaflets palmate, obovate, obcordate or emarginate, denticulate, 4" to 10" long. Heads loose, globose, on very long, axillary, angular peduncles. Flowers white, sometimes tinged with pink, fragrant, pediceled, at length reflexed. Pod about 4-seeded. Claimed by some to be the Shamrock. See No. 2. May to Sept.

XVIII. MEDICAGO, L. MEDIC. Old World herbs, very rarely shrubs, with small, pinnately 3-foliate leaves, usually toothed leaflets, and yellow or purple flowers in axillary, peduncled heads or racemes. Calyx 5-toothed. Corolla deciduous. Stamens diadelphous, 9 and 1. Pods indehiscent, variously curved, twisted, or coiled, 1 to several-seeded.

Flowers purple or violet	. . . . .	No. 1
Flowers yellow. Pods smooth	. . . . .	No. 2
Flowers yellow. Pods prickly	. . . . .	No. 3

1. *M. sativa*, L. ALFALFA. LUCERNE. BURGUNDY C. SNAIL C. A smooth, much-branched, erect, European perennial, 1° to 3° high, introduced and cultivated for fodder in the Southern and Western States and naturalized in fields and waste grounds from New Eng. to Minn. and south to Va. and Kan. Leaves petioled. Stipules awl-shaped, conspicuous. Leaflets oblong-lanceolate, toothed toward the top, often mucronate. Peduncles longer than the leaves. Flowers purple or violet, in short, oblong racemes. Pods twisted spirally like a snail shell, reticulated. June, July.

2. *M. lupulina*, L. BLACK M. HOP M. NONESUCH. An Old World annual, naturalized as a common weed in fields and waste grounds from New Eng. to Fla. and west to Iowa and Mo. Stem pubescent, procumbent, sometimes 1° to 2° long, with decumbent and spreading branches. Leaves petioled. Stipules ovate or lanceolate. Leaflets wedge-obovate. Flowers bright yellow, small, about 1" long, in a dense, oblong or cylindrical spike about 6" long, on peduncles 1' to 3' long. Pods smooth, curved, kidney-shaped, strongly veined, 1-seeded, black when ripe, the size of a pinhead. One of the so-called Shamrocks. May to Oct.

3. *M. maculata*, WILLD. SPOTTED M. A smooth, spreading or trailing annual, naturalized in waste places from New Eng. to Pa. and in some of the Southern States. Leaflets broadly obcordate, about 10" long, with a dark purplish spot near the center. Pods flat, closely coiled several turns; the margin fringed with a double row of curved, hooked prickles. May to Sept.

XIX. MELILÖTUS, TOURN. MELILOT. SWEET CLOVER. Tall, annual or biennial, Old World herbs, fragrant in drying, with pinnately 3-foliate leaves, usually toothed leaflets, and white or yellow flowers in slender, loose racemes. Calyx 5-toothed,

persistent. Corolla deciduous. Stamens diadelphous, 9 and 1. Pod ovoid or globose, coriaceous, wrinkled, exceeding the calyx, indehiscent, or opening tardily, 1 to few-seeded.

1. *M. officinalis*, WILLD. YELLOW M. YELLOW S. C. An erect, sweet-scented plant, somewhat naturalized in waste or cultivated grounds, especially in the Southern States. Stem smooth, sulcate, branching, 2° to 4° high. Leaves petioled, somewhat distant. Leaflets obovate-oblong, obtuse-toothed, 6'' to 12'' long. Racemes many, 1-sided, 2' to 4' long. *Flowers yellow*. Petals nearly equal in length. Pods ovoid, 2-seeded. June.

2. *M. álba*, LAM. WHITE M. WHITE S. C. BOKHARA OR CABUL CLOVER. An erect or ascending herb, 4° to 6° high, with *white flowers*, the standard longer than the other petals, and the leaflets narrower than in No. 1, and truncate at the apex, but in other respects similar to it. July to Aug.

XX. PSORÆLEA, L. Annual, biennial, or perennial herbs or shrubs, usually rough, especially the calyx, pods, etc., with dark glands or sprinkled with pellucid dots. Leaves mostly 3 to 5-foliolate, rarely simple. Flowers purple, blue, pink, or white, never yellow, usually in heads, spikes, or racemes. Calyx campanulate, persistent, the 5 lobes subequal or the lowest one longest. Standard ovate or orbicular. Stamens diadelphous or rarely monadelphous. Pod rarely exceeding the calyx, indehiscent, 1-seeded, often wrinkled. Root sometimes tuberous and edible.

Leaves pinnately 3-foliolate	No. 1
Leaves palmately 3 rarely 5-foliolate. Root not tuberous.	No. 2
Leaves palmately 5-foliolate. Root tuberous	No. 3

1. *P. melilotoides*, Mx. A more or less pubescent and glandular perennial herb, found in dry soils from N.C. to Fla. and west to Ind., Kan., and Tex. Stems slender, erect, somewhat branching, 1° to 2° high. Leaves petioled, pinnately 3-foliolate. Stipules subulate. Leaflets oblong-lanceolate, entire, obtuse, 1' to 3' long. Flowers purplish, about 2'' long, in loose racemes on axillary and terminal peduncles much longer than the leaves. Pods nearly orbicular, strongly wrinkled transversely. May to July.

2. *P. tenuiflora*, PURSH. A bushy-branched perennial, somewhat hoary-pubescent when young, found in prairies from Minn. and Ill. to Tex. and westward. Stem slender, erect, 2° to 4° high. Leaves short-petioled, palmately 3 rarely 5-foliolate. Stipules subulate. Leaflets varying from oval or oblong to linear, 6'' to 18'' long, glandular-dotted. Flowers purplish, 2'' to 3'' long, in loose racemes on slender peduncles longer than the leaves. Pods smooth, punctate, ovate, 2'' to 3'' long. May to Oct.

3. *P. esculenta*, PURSH. POMME BLANCHE. POMME DE PRAIRIE. PRAIRIE TURNIP, etc. A rough, hairy perennial, of the high plains and prairies from Wis. to Dak. south to Tex. Stem erect, stout, 4' to 18' high, from a spindle or turnip-shaped tuber, or cluster of tubers, about the size of a hen's egg. Leaves palmately 5-foliolate; lower ones on long petioles. Leaflets obovate or lance-oblong, 1' to 2' long. Flowers with

lanceolate bracts and calyx lobes nearly equaling the bluish corollas 6" long, in dense, oblong spikes 1' to 3' long, on longer peduncles. Pods oblong. Tubers used for food by the Indians, and known also as *Indian* or *Missouri Bread-root*. June.

XXI. AMÓRPHA, L. Shrubs, with odd-pinnate, glandular-dotted leaves, usually stipellate leaflets, and small, blue or white flowers, in dense, terminal, solitary or clustered spikes or racemes. Calyx obconical, 5-toothed, persistent. *Standard erect, concave, folded around the stamens and style; the other petals wanting.* Stamens 10, distinct, monadelphous at the base, exserted. Pod oblong, longer than the calyx, curved, tardily dehiscent, 1 to 2-seeded.

Leaves petioled; leaflets large and distant.	Pods 2-seeded	. . . . .	No. 1
Leaves sessile; leaflets small and crowded.	Pods 1-seeded	. . . . .	No. 2

1. A. fruticosa, L. FALSE OR BASTARD INDIGO. A shrub, 5° to 20° high, found along streams from southern Pa. to Wis., Minn., and the Rocky Mts. south to Fla. and Tex., and also in ornamental cultivation and escaped elsewhere. Leaves smooth or pubescent, petioled, 6' to 12' long; leaflets 13 to 25, short-stalked, distant, oblong or elliptical, 1' to 2' long. Flowers in dense, spicate racemes 3' to 6' long, with violet or purple corollas 3" to 4" long, and conspicuous orange anthers on the exserted stamens. Pod glandular, usually 2-seeded, 2 or 3 times as long as the calyx. The leaves vary considerably in cultivation. May to July.

2. A. canescens, NUTT. LEAD PLANT. A low, densely canescent, bushy shrub, 1° to 3° high, found in prairies from Ind. to Minn. south to Ga., La., and Tex. Leaves nearly or entirely sessile; leaflets 21 to 51, crowded, oval or oblong-elliptical, 4" to 6" long. Flowers bright blue, with conspicuous orange anthers on the exserted stamens, in dense spikes 2' to 5' long, usually clustered at or near the top of the plant. Pod little longer than the calyx, 1-seeded. Common name due to its lead-like color, which according to the ancient doctrine of signatures was supposed to indicate the presence of lead in the soil. July, Aug.

XXII. ASTRÁGALUS, L. Herbs, or sometimes shrubby plants, with usually odd-pinnate leaves, purple, white, or yellow flowers, mostly in spikes or racemes. Calyx 5-toothed. Corolla narrow; standard erect, oblong or ovate. Stamens 10, diadelphous. Pods few to many-seeded, usually turgid, often partly or completely 2-celled by the intrusion of one or both sutures.

Pod 2-celled, dry, dehiscent. Plant smooth or nearly so	. . . . .	No. 1
Pod 2-celled, dry, dehiscent. Plant densely villous throughout	. . . . .	No. 2
Pod 2-celled, fleshy, indehiscent, oval, pointed. Flowers purple	. . . . .	No. 8
Pod 2-celled, fleshy, indehiscent, globular, not pointed. Flowers cream-colored	. . . . .	No. 4

1. A. Canadensis, L. (A. CAROLINIANUS, L.) A smooth, somewhat pubescent, perennial herb, with erect or ascending, bushy stem, 1° to 4° high, found along streams from western N.Y. to Ga. and westward to the Rocky Mts. Leaflets 15 to 31, oblong or elliptic, 1' to 2' long. Flowers greenish-yellow, 6" to 9" long, in long, dense spikes. Pods dry, cori-

aceous, dehiscent, ovate-oblong, 5" to 6" long, smooth, terete, or slightly sulcate on the dorsal suture, nearly straight, tipped with the style. July, Aug.

2. *A. mollissimus*, Torr. WOOLLY LOCO WEED OR CRAZY WEED. A stout, bushy, densely villous and tomentose perennial, 1° to 2° high, with a very short, decumbent or ascending stem, found in prairies from Neb. to Kan. and Tex. west to Col. Leaflets 19 to 27, ovate-oblong. Flowers violet-purple, 6" to 12" long, in dense spikes on peduncles as long as the leaves. Pods narrow-oblong, 5" to 9" long, smooth, dry, cartilaginous, sulcate along both sutures, at length slightly curved. The most common of the "Loco Weeds," all said to be poisonous to cattle. June.

3. *A. caryocarpus*, Ker. GROUND PLUM. A low, leafy perennial, with prostrate or ascending, appressed-pubescent, grayish stems, 6' to 16' long, found in prairies from Minn. to Tex. and westward to Col. Leaflets 15 to 25, narrowly oblong or obovate, obtuse, 3" to 6" long. Flowers violet-purple, 8" to 10" long, in short, rather loose racemes on peduncles about as long as the leaves. Pods smooth, oval or ovate, pointed, 8" to 12" in diameter, succulent, becoming fleshy, edible, and gathered by prairie dogs for winter use. See next species. April to June.

4. *A. Mexicānus*, A. DC. LARGER GROUND PLUM. A perennial similar to No. 3, but with smoother, taller, and greener stems, found on prairies or open plains from Ill. to Neb. south to Tex. Leaflets 17 to 33, obovate or oblong. Flowers larger, 10" to 12" long, cream-colored, purplish only at the tip, in short racemes. Pods globular, pointless, smooth, fleshy, 12" to 15" in diameter, edible. The popular names of this and No. 3 are due to the resemblance of their unripe fruits to green plums, and are eaten raw or cooked. May.

XXIII. TEPHRÒSIA, Pers. HOARY PEA. Perennial herbs or shrubs, with usually odd-pinnate leaves, and red, purple, or white flowers, mostly in racemes. Calyx 5-cleft; teeth subulate, subequal. Petals clawed; standard roundish; wings coherent with the obtuse keel. Stamens diadelphous in the species here given, or monadelphous. Pods flattened, linear, 2-valved, many-seeded.

1. *T. Virginiana*, Pers. GOAT'S RUE. CATGUT. An erect, silky-pubescent perennial, with a simple, very leafy stem, 1° to 2° high, common in dry, sandy soils from southern New Eng. to Minn. south to Fla. and La. Leaflets 17 to 29, oblong or linear-oblong, mucrovate, 10" to 12" long. Flowers 6" to 10" long, crowded in a short, terminal, sometimes compound raceme, subsessile among the leaves. Standard white or yellowish; keel pink; wings red. Pods linear, downy, 1' to 2' long. The long, slender, tough roots give the plant one of its common names. June, July.

XXIV. ROBÍNIA, L. LOCUST. Trees or shrubs, with odd-pinnate leaves, showy flowers in axillary and terminal racemes, and often with spiny stipules. Leaflets stipellate. Bases of the petioles covering the buds of the next year. Calyx short, campanulate, 5-toothed, somewhat 2-lipped. Standard large, roundish, reflexed, about as long as the wings and keel. Stamens diadelphous, 9 and 1. Pod flat, linear, margined on the

upper or seed-bearing edge, several-seeded, at length 2-valved. Species all North American.

1. *R. Pseudacácia*, L. COMMON LOCUST. YELLOW L. BLACK L. FALSE ACACIA. A large tree, 30° to 80° high, with rough bark and smooth or nearly smooth twigs and leaves, native in Pa. south to Ga. west to Iowa and Ark., and naturalized extensively in New Eng. Stipules usually spiny. Leaflets 11 to 21, oval or ovate, stalked, entire, 1' to 2' long. Stipels minute, setaceous, deciduous. Flowers white, 7'' to 10'' long, fragrant, in loose, drooping racemes. Pod smooth, 2' to 4' long, 4 to 6-seeded. Wood very durable. May, June.

2. *R. viscosa*, VENT. CLAMMY L. Usually a cultivated shrub, 5° to 6° high, but known also as a small tree, 30° to 40° high, in the mts. of southwestern Va., N.C., and Ga. Bark smooth. Branchlets, leafstalks, and pods glandular-viscid. Leaflets 13 to 21, stalked, oblong, oval or ovate, entire, 1' to 2' long. Flowers pink, 9'' to 12'' long, in oblong, rather dense, often erect, clammy, hairy racemes, slightly fragrant. Pods about 3' long, glandular-hispid, with 5 to 9 brownish seeds. June.

3. *R. hispida*, L. BRISTLY L. MOSS L. ROSE ACACIA. An ornamental shrub, 3° to 5° high, native in the mts. from Va. to Ga. Stem branching, straggling. Branchlets, petioles, pedicels, and pods clothed with stiff, bristly hairs. Stipules small or none. Leaflets 9 to 13, stalked, broadly ovate or oval, entire, 1' to 2' long. Flowers deep rose-color, inodorous, 8'' to 15'' long. Pod linear. May to July.

XXV. CÉRCIS, L. Small trees or shrubs, with heart-shaped, simple leaves, caducous stipules, and rose-colored flowers. Calyx bell-shaped, 5-toothed, red. Corolla imperfectly papilionaceous, the standard inclosed by the wings in the bud. Stamens 10, distinct. Pod flat, oblong-linear, many-seeded, narrowly winged on the ventral suture.

1. *C. Canadensis*, L. REDBUD. AMERICAN JUDAS TREE. A small tree, 20° to 30° high, common in rich soils from N.Y. and N.J. west to southern Minn. and Kan. south to Fla. and Tex. Leaves petioled, round-cordate, 3' to 4' long, short-acuminate, smooth, pubescent on the veins beneath, with 5 to 7 prominent ribs radiating from the base. The rose-purple flowers, appearing before the leaves in small, lateral, umbel-like clusters and completely covering the branches, make the tree very conspicuous. The original Judas tree, so named by Gerarde, is a European species, *C. Siliquastrum*, L. April.

XXVI. CÁSSIA, L. Herbs, shrubs, or in warm regions trees, with abruptly pinnate leaves and mostly yellow, nearly regular flowers. Sepals 5, more or less united at the base. Petals 5, unequal and spreading, but not papilionaceous. Stamens separate, 10 or fewer, unequal, spreading, some often imperfect. Anthers opening by terminal chinks or pores. Pod many-seeded, 1-celled, or by cross partitions many-celled.

Stamens 10; 8 imperfect. Leaflets large Nos. 1, 2, 3
Stamens 10 or 5; all perfect. Leaflets small Nos. 4, 5

1. *C. Marilandica*, L. WILD OR AMERICAN SENNA. A smooth perennial, 3° to 5° high, of wet lands from New Eng. to Fla. west to Neb. and La. Stems nearly simple. Leaflets 6 to 9 pairs, oblong-lanceolate, obtuse, mucronate, 1' to 2' long, with a club-shaped gland near the base of the common petiole. Stipules caducous. Flowers bright yellow, 8'' or 9'' wide, in short racemes in the upper axils, often appearing as if panicked. Sepals obtuse. Pod linear, 3' to 4' long, curved, downy, becoming smooth, 12 to 20-seeded. Aug.

2. *C. occidentalis*, L. COFFEE SENNA. A common annual, of waste places in the Southern States as far north as Va. and southern Ind. Stem smooth, stout, branching, 1° to 5° high. Leaflets 4 to 6 pairs, ovate-lanceolate, acute, 1' to 2' long, with a globular gland at the base of the common petiole. Stipules caducous. Racemes 2 to 4-flowered. Sepals obtuse. Pod linear, slightly curved, smooth, 3' to 4' long. July, Aug.

3. *C. obtusifolia*, L. (*C. TORA*, L.) LOW SENNA. An annual of the same range and habitat as the preceding. Stem slender, 1° to 3° high. Leaflets 3 rarely 2 pairs, *obovate-obtuse*, with a tooth-like gland between the lowest pair. Stipules deciduous. Flowers in pairs. Pod linear, very slender, 4-angled, strongly curved, 6' to 10' long. July to Oct.

4. *C. Chamæcrista*, L. PARTRIDGE PEA. An annual, of sandy fields and dry soils from New Eng. to Ga. west to Ind., Kan., and Tex. Stem spreading, smooth or downy, 6' to 18' high. Leaflets sensitive to the touch, 10 to 15 pairs, linear-oblong, obtuse, mucronate, 4'' to 10'' long, with a sessile gland on the main petiole. Stipules and bracts linear-awl-shaped, persistent. Flowers large, 15'' to 18'' broad, *bright yellow, the two upper petals often with purple spots*, 2 to 4 in each cluster, on long pedicels above the axils. Anthers 10, perfect, unequal. Pod linear, nearly straight, erect. Aug.

5. *C. nictitans*, L. SENSITIVE PEA. WILD SENSITIVE PLANT. An erect or decumbent branching annual, 6' to 15' high, and somewhat pubescent, of about the same range and habitat as the preceding. It resembles it also in the smallness and sensitiveness of the leaflets and in its glands and stipules. It differs from it mainly in *having its flowers much smaller, 2'' to 4'' wide, pale yellow, on short pedicels*, and with only 5 anthers. July.

XXVII. GLEDITSCHIA, L. Trees with supra-axillary thorns, equally pinnate or bipinnate leaves, small stipules, and spicate racemes of small, greenish, polygamous flowers. Calyx cup-shaped, 3 to 5-cleft. Petals 3 to 5. Stamens 6 to 10, separate. Pod flat, linear, or oval, 1 to many-seeded. Seeds flat, often with pulp between them.

1. *G. triacanthos*, L. HONEY LOCUST. THREE-THORNED ACACIA. A large tree, native from Pa. and western N.Y. to Mich. and Kan. south to Ga., La., and Tex., and often cultivated elsewhere. Thorns rarely simple, mostly branching, especially triple (*triacanthos*), 2' to 6' long, numerous, in masses on the trunk or branches. Leaves pinnate, with 20 to 30 leaflets, or bipinnate, with 8 to 12 pinnæ on the same tree, the transformation of leaflets into pinnæ often occurring in the same compound leaf. Leaflets oblong-lanceolate, obtuse, 8'' to 16'' long. Flowers less than 3'' wide, in dense, drooping, solitary, or clustered racemes. Pods 12' to 16' long, 1' or more wide, flat, twisted, reddish. Seeds hard, brown, flat, imbedded in sweet pulp (whence the name "Honey Locust"), which soon becomes sour. June.

2. *G. aquática*, MARSH. WATER, OR SWAMP LOCUST. A smaller tree than the preceding, found in swamps from Ind. to Mo. south to S.C. and La. Thorns mostly simple, slender. Leaflets oblong or ovate. Pods obliquely oval, about 1' long, 1-seeded, pulplless. June, July.

XXVIII. GYMNOCLADUS, LAM. Trees, with stout, sprayless branchlets, equally or unequally bipinnate leaves, and terminal racemes of white, dicecious or polygamous, regular flowers. Calyx tubular, with 5-lobed limb. Petals 5, oval or oblong, inserted at the top of the calyx tube. Stamens 10, distinct. Ovary (in pistillate flowers) sessile; style 1. Pod oblong, flat, coriaceous, 1-celled, several-seeded, pulpy within. Monotypic.

1. *G. Canadensis*, LAM. KENTUCKY COFFEE TREE. STUMP TREE. A large tree, of rich woods from western N.Y. and Pa. to Tenn. and west to Minn., eastern Neb., and Kan. Bark rough and scaly. Leaves petioled, bipinnate, 2° to 3° long, 15' to 20' wide, with ovate, acuminate, entire, dull, dark green leaflets 1' to 3' long. Flowers greenish-white in long, terminal racemes. Pods 6' to 10' long, 2' wide. Seeds round, flattish, polished and very hard, 6'' to 8'' in diameter. The use of its seeds as a substitute for coffee has given it one of its common names; and the stumpy appearance of its branches in winter, the other. May, June.

XXIX. MIMOSA, L. Chiefly perennial herbs, sometimes shrubs or trees, of tropical America and other warm regions, with bipinnate leaves, often sensitive, and small, polygamous, white or rose-colored flowers, in globose heads or cylindrical spikes on axillary peduncles. Calyx minute, 4 to 5-toothed. Petals united into a 4 to 5-cleft, tubular-campanulate corolla. Stamens 4 to 10, distinct, much exserted. Legume flat, mostly jointed, 1 to many-seeded.

1. *M. strigillōsa*, TORR AND GRAY. A prostrate, spreading perennial, growing along the banks of rivers from eastern Fla. west to the Miss. Stems reddish, several feet long, apparently smooth, but really rough with scattered, appressed, stiff hairs. Leaves on petioles 6' to 8' long, bipinnate, with 4 to 6 pairs of pinnæ and 10 to 14 pairs of oblong-linear, crowded leaflets, each 3' to 4' by 1'. Peduncles longer than the leaves, with elliptical heads of rose-colored flowers. Pod oval or oblong, 1 to 3-jointed, hispid. July, Aug.

2. *M. pudica*, L. SENSITIVE PLANT. An erect, hairy, and prickly perennial from Brazil, about 1° high, usually cultivated as an annual. Leaves digitate-pinnate, with 4 pinnæ, each of 20 or more pairs of linear leaflets, each about 3'' long. Flowers many, small, red, in oblong-globose heads, on long peduncles. Cultivated for its sensitive leaves which, when touched, fall and close their leaflets. More sensitive than *M. sensitiva*, L., a half-climbing perennial with but 2 pinnæ, ovate leaflets, and purple flowers.

XXX. SCHRANKIA, WILLD. SENSITIVE BRIER. Perennial herbs or shrubs, mostly prostrate, with bipinnate, generally

sensitive leaves, and small, polygamous or perfect, pink or purple flowers, in axillary, peduncled heads or spikes. Stem, petioles, peduncles, and pods armed with short, recurved prickles. Calyx minute, 5-toothed. Petals united in a 5-cleft, funnel-shaped corolla. Stamens 8 to 10, distinct, or united at the base. Pod long and narrow, prickly, dry, 1-celled, many-seeded, 4-valved.

1. *S. uncinata*, WILLD. A decumbent, branching, perennial herb, 2° to 4° long, armed in all its parts with short, sharp, hooked prickles, found in dry soils from Va. to Fla. west to Ill., Neb., and Tex. Stem angled and grooved. Leaves petioled; pinnæ 4 to 7 pairs; leaflets 8 to 14 pairs, minute, elliptic-oblong, about 3" long, reticulate beneath, with elevated veins. Flowers pink, in dense, globose heads, nearly 1' in diameter, on peduncles 2' to 3' long. Pods terete, very prickly, 2' to 4' long. May to July.

XXXI. DESMANTHUS, WILLD. Perennial herbs or shrubs, with equally bipinnate leaves, minute, setaceous stipules, and heads or spikes of small, regular, greenish or whitish flowers on axillary peduncles. Petioles with one or more glands. Flowers perfect or polygamous. Calyx bell-shaped, 5-toothed. Petals 5, distinct. Stamens 5 or 10, distinct. Pod dry, flat, smooth, linear or oblong, straight or curved, several-seeded.

1. *D. brachylobus*, BENTH. A nearly smooth, perennial herb, with erect or ascending, angled stems, 1° to 4° high, with bipinnate leaves, found in prairies and alluvial soil from Ind. and Ky. to Minn., Mo., and Tex.; also in Fla. Pinnæ 6 to 12 pairs. Leaflets 20 to 30 pairs, linear-lanceolate, acute, 1" to 2" long. Flowers perfect, pentandrous, greenish-white, in dense, globose heads. Pods linear, 1' long, slightly curved, 2 to 6-seeded. June to Aug.

XXXII. ALBIZZIA, DURAZZ. Ornamental trees or shrubs, of tropical or subtropical Asia, Africa, and Australia, with bipinnate leaves, and spikes or globular heads of yellowish, white or red flowers on axillary peduncles. Calyx tubular, 5-lobed. Corolla funnel-shaped, 5-lobed. Stamens many, long, exserted. Pods flat, broadly linear, thin.

1. *A. Julibrissin*, DURAZZ. SILK FLOWER. SILK TREE. A smooth, unarmed, ornamental tree, 30° to 40° high, from Asia and Africa, cultivated and sparingly naturalized in the Gulf States, and hardy as far north as Washington, D.C. Leaves with 8 to 12 pairs of pinnæ, each with 20 to 30 pairs of oblong, linear, inequilateral, falcate leaflets, each 3" long. Flowers pink or white, in pedunculate heads, forming terminal panicles. The lustrous silk-like filaments of the numerous, long, exserted stamens give the tree its common name.

ORDER 36. ROSACEÆ — ROSE FAMILY

Herbs, shrubs, or trees, with alternate, rarely opposite, simple or compound, *mostly stipulate leaves*, and *regular, perfect, rarely polygamous flowers*. *Sepals 5, rarely fewer or more, united at the base and sometimes subtended by as many bractlets*. *Petals as many as the sepals, rarely absent, distinct, usually imbricated in the bud, inserted on the edge of a disk which lines the calyx tube*. *Stamens many, rarely few, distinct, inserted with the petals*. *Pistils 1 to many, distinct, or coherent with the calyx, as in the Apple Subfamily*. *Fruit a drupe, a pome, akenes, follicles, or an aggregation of drupelets*. *Seeds 1 to few in each carpel, anatropous, usually without albumen*. *Embryo straight*.

Key to Genera

- DRUPACEÆ — PLUM OR PEACH SUBFAMILY.** Trees or shrubs. Fruit a drupe. Drupe smooth or velvety. Stone smooth or rough . **PRUNUS** I
- POMACEÆ — APPLE OR PEAR SUBFAMILY.** Fruit a pome.
- Pome with 2 to 5 bony, 1-seeded nutlets **CRATÆGUS** II
- Pome with 2 to 5, thin, cartilaginous, 2-seeded carpels **PYRUS** III
- Pome usually 10-celled and berry-like **AMELANCHIER** IV
- ROSACEÆ proper — ROSE SUBFAMILY.** Fruit 2 to many akenes, drupelets, or follicles.
- a. Calyx in fruit an urn-shaped tube. (1)
- a. Calyx in fruit not an urn-shaped tube. (b)
- b. Pistils usually 5, becoming follicles in fruit. (3)
- b. Pistils becoming 1 to 2-seeded drupelets in fruit. (3)
- b. Pistils becoming akenes in fruit. (4)
1. Calyx tube fleshy. Flowers large **ROSA** V
1. Calyx tube dry. Flowers small **AGRIMONIA** VI
2. Follicles 1 to 10-seeded, 1-valved, not inflated. Petals obovate **SPIRÆA** VII
2. Follicles 2 to 4-seeded, 2-valved, inflated. Petals obovate **PHYSOCARPUS** VIII
2. Follicles 2 to 4-seeded. Petals linear-lanceolate **GILLENIA** IX
3. Drupelets pulpy **RUBUS** X
3. Drupelets dry **DALIBARDA** XI
4. Akenes few, 2 to 8 **WALDSTEINIA** XII
4. Akenes numerous, in a head, tipped with the styles **GEUM** XIII
4. Akenes numerous, on a pulpy, globular receptacle **FRAGARIA** XIV
4. Akenes numerous, on a dry receptacle **POTENTILLA** XV

I. PRUNUS, BENTH AND HOOK. PLUM. APRICOT. CHERRY. PEACH. ALMOND. Small trees or shrubs, with alternate, simple leaves, small, free, early deciduous stipules, and regular, perfect, white or rose-colored, solitary or clustered flowers, and usually edible fruit. Calyx lobes and petals 5, spreading. Stamens 15 to 30 or indefinitely numerous and perigynous. Pistil single. Ovary superior, 2-ovuled, becoming in fruit a 1-seeded, simple drupe or stone fruit.

BRIEF FLORA — 8

- § 1. *PRUNUS* proper. Plums and apricots. Drupe smooth, sulcate. Stone flattened.
 Flowers white, stalked, umbeled. Drupes glaucous more or less . . . Nos. 1 to 4
 Flowers pink, sessile, solitary. Drupes not glaucous . . . No. 5
- § 2. *CÉRASUS*. Cherries. Fruit smooth. Stone globular.
 Leaves evergreen. Flowers in erect racemes . . . No. 6
 Leaves deciduous. Flowers in drooping racemes . . . Nos. 7, 8
 Leaves deciduous. Flowers in umbels . . . Nos. 9 to 11
- § 3. *AMYGDALUS*. Peaches and almonds. Fruit downy. Stone rough.
 Drupe soft, not opening or splitting when ripe . . . No. 12
 Drupe soft, splitting when ripe . . . No. 18

1. *P. Americana*, MARSH. COMMON WILD PLUM. WILD YELLOW OR RED P. A small, spreading tree, 8° to 20° high, with smooth, reddish-green bark and thorny branches, common along streams and in low woods from N.J. and N.Y. to Fla. and Col. Leaves oval or obovate, 2' to 3' long, acuminate, coarsely or doubly serrate, coarsely veined, never glossy. Flowers large, white, in umbeled clusters of 3 to 4 from separate, lateral buds. Fruit roundish-oval, dull orange or crimson, scarcely glaucous. Stone flattened, smoothish, margined, ripe in Aug. May.

2. *P. angustifolia*, MARSH. (*P. CHICASA*, Mx.) CHICKASAW PLUM. A small tree, 6° to 15° high, with slender, reddish, zigzag, somewhat thorny branches, found in dry soils from southern N.J. to Fla. west to the Rocky Mts., and often cultivated. Leaves conduplicate and trough-like when young; long, narrow, nearly lanceolate, acute, glandular-serrulate, thin, 3' to 5' long, smooth when mature. Flowers white, in umbels of 2 to 3, on short pedicels. Fruit small, cherry-like, thin-skinned, without bloom, yellowish-red. Stone globular. Ripens from May to July. April.

3. *P. Wátsoni*, SARGENT. SAND PLUM. A bushy shrub, 3° to 8° high, with more zigzag and spiny twigs, smaller leaves and flowers, and a thicker-skinned fruit than No. 2, found in dry, sandy soils from Neb. to Ark. April, May.

4. *P. domestica*, L. COMMON GARDEN P. DAMSON P. A small, Old World tree, probably from western Asia, long cultivated and in many varieties. Leaves usually ovate or obovate, 1' to 3' long, on petioles one third as long, irregularly and coarsely serrate, rugose, dull green and thick. Flowers white, solitary or fascicled, expanding with the leaves. Fruit black, varying to lighter colors, very glaucous. More than 100 varieties are in cultivation. April, May.

5. *P. Armeniaca*, L. APRICOT. A small, round-headed, Old-World tree, cultivated for its fruit. Bark reddish, resembling that of the peach tree. Leaves thin, bright green, rather smooth, round-ovate, 2' to 3' long, on long petioles, abruptly pointed, subcordate, denticulate. Flowers pink-white, nearly or entirely sessile, solitary, appearing before the leaves. Fruit, resembling both the plum and the peach, subglobose, 1' to 2' in diameter, reddish or yellowish, smooth. Stone flattened, smooth, free, ridged or grooved on one side. April.

6. *P. Caroliniána*, AIT. AMERICAN CHERRY LAUREL. WILD ORANGE. MOCK ORANGE. A small, evergreen tree, 20° to 40° high, with smooth, glossy, coriaceous, oblong-lanceolate, mostly entire leaves 24" to 30" long, on short petioles, found along river banks and in ornamental cultivation from N.C. to Fla. and Tex. Flowers with white calyx and corolla, small, in erect, dense axillary racemes shorter than the leaves. Fruit ovoid, about 4" long, black, not glaucous, bitter, soon dry, persistent. Stone globular. Feb., March.

7. *P. serótina*, EHRH. WILD CHERRY. WILD BLACK CHERRY. A large tree, 50° to 80° high, common in woods and open places from Me. to Minn., Fla., and Tex. Bark reddish when young, blackish and rough

when old. Leaves thick, oval-lanceolate or ovate, 3' to 5' long, acute or acuminate, smooth and shining above, serrate with appressed, incurved callous teeth. Flowers white, in long, loose, terminal, spreading or drooping racemes. Fruit globose, 3'' to 4'' in diameter, nearly black, bitterish, but with an agreeable vinous flavor. Blooms in May or June and fruit *ripens late* in the summer as indicated by its specific name (*serotina*). Wood valuable for cabinet work. Bark bitter-aromatic and tonic.

8. *P. Virginiana*, L. CHOKER CHERRY. A tall shrub or small tree, 5° to 20° high, with grayish bark, common along river banks from Me. to Minn. south to Ga. and Tex. Leaves thin, smooth, dull, oval, oblong, or obovate, 2' to 3' long, abruptly pointed, sharply or doubly serrulate, on petioles with 2 or 3 glands. Flowers white, in loose, erect or spreading, terminal racemes, blooming in May. Fruit dark red, globose, 3'' to 4'' in diameter, very astringent, but edible when fully mature. Stone globular, smooth.

9. *P. Pennsylvanica*, L.f. WILD RED, BIRD, OR PIN CHERRY. A small tree, 20° to 30° high, with smooth, reddish-brown bark, common in rocky woods and thickets from Me. to N.C. west to the Rocky Mts. Leaves oblong-lanceolate, 2' to 5' long, acute or acuminate, finely serrate, smooth on both sides, shining-green. Flowers white, appearing with the leaves on slender pedicels, in corymb, peduncled or sessile clusters. Fruit cherry-red, without bloom, globose, 2'' to 3'' in diameter, with thin and sour flesh and globular stone. May.

10. *P. Avium*, L. BIRD C. SWEET C. An Old World tree, 20° to 50° high, with erect or ascending branches, giving it an oblong or pyramidal head, extensively cultivated, and in the Eastern States somewhat escaped and naturalized. Trunk robust; bark reddish-brown. Leaves soft in texture, dull in color, generally oval or oblong-ovate, gradually or abruptly acuminate, 3' to 5' long, coarsely or doubly serrate, on glandular petioles. Flowers white, in scaly, sessile, lateral umbels, appearing with the leaves. Fruit globose, generally black or dark red and sweet. The source of numerous varieties of sweet cherries and of some sour ones, as the *May Dukes*.

11. *P. Cerasus*, L. SOUR C. MORELLO. EARLY RICHMOND. An Old World tree, 10° to 30° high, with gray bark and rounded head, like the preceding often cultivated and similarly escaped and naturalized. Leaves ovate or obovate, abruptly short-pointed, smooth, hard and stiff, light green, more or less glossy above. Flowers white, in sessile, scaly umbels from lateral buds, appearing usually before the leaves. Fruit roundish, red in various shades, acid. The parent like the preceding of numerous varieties, but usually tart or sour ones, as the *Morellos*, *Early Richmonds*, etc.

12. *P. Persica*, SIEB. AND ZUCC. PEACH. A small, Oriental tree, 6° to 15° high, formerly supposed to be from Persia, whence its specific name, but now believed to be from China, widely cultivated in numerous varieties for its fruit. Leaves conduplicate when young, lanceolate, 3' to 5' long, serrate, smooth, on short petioles, with 1 or 2 glands. Flowers rose-colored, solitary, subsessile, preceding the leaves. Fruit soft, downy, yellowish, tinged with pink and purple. Stone deeply pitted, oval, flattish, very hard. Var. *lævis*, GRAY (or *nectarina*, MAXIM.), with smaller, smooth fruit and generally more strongly serrated leaves, is the NECTARINE. Var. *platycarpa*, BAILEY, from China, very much flattened at the ends, is the PEEN-TO OR FLAT PEACH of the Gulf States.

13. *P. Amygdalus*, BAILL. ALMOND. An Oriental tree, 10° to 25° high, very similar to the peach in habit, foliage, and flowers, but the flesh of its fruit is dry and hard and splits open when ripe and releases its large and rather soft stone, the almond of the table.

II. CRATÆGUS, L. HAWTHORN. Shrubs or small trees, usually thorny, with simple, usually serrate or lobed leaves and white or pink flowers in terminal corymbs or cymes, or rarely solitary. Calyx cup-shaped, with 5 spreading lobes. Petals 5, spreading, rounded. Stamens many, rarely 10 to 5. Styles 1 to 5. Fruit a pome, inclosing 2 to 5, rarely 1, 1-seeded stones and tipped with the 5 persistent calyx teeth.

N.B. — A difficult genus. Species very variable.

Native. (a)

Exotic or naturalized. (f)

- a. Flowers many (6 to 80), in a corymb. (b)
- a. Flowers few (8 to 6), in a corymb, in pairs or solitary. (e)
- b. Leaves distinctly lobed except in No. 2. (c)
- b. Leaves not lobed or but slightly so. (d)
- c. Flowers small; styles 5. Fruit small, depressed, globous, coral-red. Nos. 1, 2
- c. Flowers small; styles 1 to 8. Fruit small, ovoid or oval, coral-red. No. 3
- d. Leaves on slender, glandular petioles, slightly lobed. No. 4
- d. Leaves on short, stout petioles, not glandular. Fruit erect, soft. No. 5
- d. Leaves on very short petioles. Fruit nodding or dotted. Nos. 6, 7
- e. Leaves smooth; petioles and teeth glandular. No. 8
- e. Leaves pubescent, coriaceous; not glandular. Trees. No. 9
- e. Leaves pubescent, coriaceous; not glandular. Shrubs. No. 10
- f. Leaves deciduous. No. 11
- f. Leaves evergreen. No. 12

1. C. cordata, Ait. WASHINGTON THORN. A compact, close-headed tree, 15° to 25° high, with many slender thorns 1' to 2' long, native in woods from Va., Ky., and Ill. to Ga. and Ala., and often cultivated for hedges in the Middle States. Leaves broadly triangular-ovate or cordate, 1' to 3' long, often deeply 3 to 5-lobed, serrate, thin, smooth, deep shining green, on slender petioles. Flowers many, white, small, 4'' to 5'' wide, appearing in May and June. Fruit depressed-globous, 2'' to 3'' in diameter, coral-red, ripe in Sept.

2. C. spathulata, Mx. SMALL-FRUITED HAW. A shrub or small tree, 10° to 20° high, common along river banks from Va. to Fla. and Tex. Leaves thick, shining, *spatulate*, crenate toward the apex, nearly sessile; those of the young, downy branches somewhat cut or lobed. Flowers white, small, 4'' to 5'' wide, in large clusters in May. Fruit depressed-globose, 2'' to 3'' in diameter, coral-red, ripe in Oct.

3. C. apiifolia, Mx. PARSLEY-LEAVED T. PARSLEY HAW. A shrub or low, spreading tree, 10° to 20° high, with flexible branches and white-downy twigs. Spines stout, 1' to 2' long. Leaves small, 6'' to 18'' long, broadly ovate in outline, with a broad, truncate or heart-shaped base, pinnatifid with 5 to 7 crowded, irregularly toothed lobes, white and soft-downy when young, smoothish when fully grown. Petioles slender. Flowers many, white, 5'' to 6'' across, in May and June. Fruit ovoid or oval, 3'' to 4'' long, coral-red, ripe in autumn.

4. C. coccinea, L. WHITE THORN. SCARLET-FRUITED T. A tall shrub or low tree, 10° to 25° high, common in hedges and woods from Canada to Fla. Branches reddish; spines chestnut brown, 1' to 2' long. Peduncles and calyces glandular and villous-pubescent. Leaves bright green, thin, smooth, pubescent beneath, roundish-ovate, 2' to 3' long, serrate, with glandular teeth, sharply cut-toothed or lobed, and on slender petioles. Flowers large, 8'' to 12'' wide, white, 10 to 15, in paniced, lateral corymbs in May. Fruit round or pear-shaped, 5'' to 6'' in diameter, scarlet or bright purple, ripe and edible in Sept. *Var. macracantha, Dudley,*

ranging from New Eng. to Va. and westward. has thorns 2' to 5' long, dull, dark green leaves on rather stout petioles, and larger flowers and fruit. *Var. mollis*, TORR. AND GRAY, has the shoots and undersurfaces of the leaves densely pubescent, and the fruit larger and light scarlet, with a bloom.

5. *C. tomentosa*, L. BLACK THORN. HAWTHORN. PEAR HAWTHORN. A shrub or small tree, 15° to 20° high, with slender, contorted branches, forming a wide, flattish head, ranging from western N.Y. to N.J. and Ga. west to Mich. and Mo. Branches gray and unarmed, or with stout, short thorns 1' to 2' long. Twigs, peduncles, and calyx hairy. No glands on stipules, bracts, or calyx teeth. Leaves broadly ovate or oval, 2' to 5' long, finely serrate, often incisely lobed, abruptly narrowed into a short-margined petiole, downy-pubescent beneath; veins straight, strongly sulcate. Flowers ill-scented, small, with 1 to 3 styles, many in a tomentose corymb, in May or June. Fruit 6'' long, upright, pear-shaped, or oval to globose, dull red, ripening in Sept. or Oct., and remaining on the branches all winter.

6. *C. Crus-galli*, L. COCKSPUR THORN. NEWCASTLE T. A shrub or small tree, 10° to 30° high, with rigid, widely spreading, often somewhat drooping branches, and many slender spines often 4' long, common in thickets from New Eng. to Fla. and Tex. Leaves thick, smooth, shining, dark green above, wedge-obovate, 1' to 2' long, tapering to a short petiole, finely serrate above the middle, obtuse or abruptly acuminate; varying considerably in cultivation. Flowers white, fragrant, 6'' wide, 12 to 18, in short, lateral corymbs, in May or June. Fruit globular or pear-shaped, 4'' to 6'' long, dull red, ripening in Sept. and Oct., and remaining on the tree through the winter.

7. *C. punctata*, JACQ. DOTTED-FRUITED T. DOTTED HAW. A shrub or tree, 10° to 25° high, with rough, dark, reddish-brown bark, and slender, rigid, horizontal, or spreading branches, ranging from Canada to Tenn., or in the mts. to Ga. and Ala. Thorns, when present, straight, sharp, 2' to 3' long. Leaves thick, pale green and smooth above, hairy beneath, wedge-obovate, 2' to 3' long, tapering to long, winged petioles, unequally and sharply serrate above the middle, acute or rounded at the apex. Veins prominent beneath, sulcate above. Flowers white, 6'' to 9'' wide, in May and June, 8 to 15, in broad, downy, or tomentose corymbs. Fruit globular or elongated, 9'' to 12'' long, dull red or yellow, *dotted* (*punctata*) with many small, white spots; ripening and falling in Sept.

8. *C. flava*, AIT. YELLOW OR SUMMER HAW. A low, spreading, usually very thorny tree, 15° to 25° high, in sandy soils from Va. to Fla. west to Mo. and Tex. Leaves wedge-obovate, 1' to 2' long, unequally cut and glandular-toothed above the middle. Stipules and petioles also glandular. Flowers 1 to 3 in a corymb, mostly solitary, white, 8'' to 9'' wide; styles 4 to 5; blooming in May. Fruit globose or somewhat pear-shaped, 5'' to 7'' broad, yellow, greenish-yellow, or tinged with red, ripening in autumn.

9. *C. æstivalis*, TORR. AND GRAY. MAY HAW. APPLE HAW. A small tree, 15° to 30° high, on the margins of pine barren ponds and along low streams from S.C. to Fla. west to Ark. and Tex. Leaves rigid, pubescent, becoming smooth above, rusty-pubescent on the veins beneath, obovate or wedge-obovate, 2' to 3' long, crenate above the middle, tapering to a short petiole; without glands. Flowers 3 to 5 in smooth corymbs in March and April. Fruit depressed-globose, 6'' to 7'' in diameter, bright red, juicy, agreeably acid, ripening in May, and much used for tarts, preserves, and jellies.

10. *C. uniflora*, MUENCH. (*C. parvifolia*, AIT.) DWARF THORN. A low, dense, scraggy shrub, 3° to 6° high, found in sandy flats from southern N.Y. and N.J. to Fla. and La. Thorns many, slender, 1' to 2' long. Leaves coriaceous, obovate, crenate, tapering to a nearly sessile base, 6'

to 18" long, pubescent beneath, finally shining above. Flowers, appearing in April and May, mostly solitary, nearly sessile, 5" to 7" wide, with the incised, leafy, glandular-toothed calyx lobes as long as the petals. Styles 5. Fruit globose or pear-shaped, 5" to 6" long, hairy at first, greenish-yellow, ripening and falling in Sept.

11. *C. Oxyacantha*, L. ENGLISH HAWTHORN. MAY. An Old World shrub or small tree, 8° to 15° high, extensively used in Europe for hedges, sometimes cultivated in this country for the same purpose or for ornament, and sparingly escaped and naturalized. Branches spreading. Thorns many, stout, sharp, axillary. Leaves smooth, thick, shining above, slender-petioled, wedge-obovate, 1' to 2' long, cut-lobed and toothed; no glands. Flowers fragrant, white, rose, or pink-red, 5" to 7" wide, 5 to 10 in a corymb; often double. Styles 1 to 3. Fruit globose or roundish-oval, 3" to 5" long, coral-red, ripening in autumn. Many varieties are in cultivation.

12. *C. Pyracantha*, Pers. EVERGREEN THORN. An ornamental shrub, 4° to 6° high, from southern Europe, sparingly escaped from cultivation and naturalized from southern Pa. southward. Leaves smooth, evergreen, ovate-lanceolate or spatulate-lanceolate, crenate or crenulate, about 1' long, on short, pubescent petioles. Flowers white, small, in small cymose clusters, blooming in May. Fruit coral-red, globose, about the size of small peas, ripening in autumn and remaining on the branches nearly all winter.

III. *PYRUS*, BENTH AND HOOK. PEAR, APPLE, QUINCE, etc. Shrubs or trees, sometimes thorny, with mostly simple leaves, and white or rose-colored flowers in cymes or corymbs, or rarely solitary, and yielding many valuable fruits. Calyx urn-shaped; limb 5-cleft. Petals 5, roundish. Stamens usually many. Styles 2 to 5. Ovary 2 to 5-celled with 2 ovules, or sometimes, as in the *CYDONIA* section, with several ovules in each cell. Cells cartilaginous, inclosed in the fleshy part of the pome. The genus is polymorphous, treated by some as several distinct genera, which are recognized as sections (§) or subgenera in the key below.

§ <i>PYRUS</i> proper. Leaves simple, glandless. Flowers in simple corymbs or clusters. Styles distinct. Pome usually tapering downward . . .	No. 1, 2
§ <i>MALUS</i> . Leaves simple, glandless. Flowers in simple umbels or clusters. Styles united below except in No. 7. Pome usually globular and depressed at the ends . . .	No. 3 to 7
§ <i>ARONIA</i> . Leaves simple, with glands above on the midveins. Flowers in compound cymes. Styles united below. Pomes berry-like . . .	No. 8
§ <i>SORBUS</i> . Leaves pinnate, of 9 to 17 leaflets. Flowers white in large terminal compound cymes. Pomes berry-like, red . . .	No. 9, 10
§ <i>CYDONIA</i> . Leaves simple, glandless. Flowers white or red, single or 2 or 3 together. Pome large, more or less pear-shaped. Cells several to many-seeded . . .	No. 11, 12

1. *P. communis*, L. PEAR. A long-lived, upright, Old World tree, 20° to 40° high, long cultivated for its fruit. Branches ascending, sometimes thorny. Leaves ovate or oblong-ovate, acute, 2' to 3' long, on petioles 1' to 2' long, hard, veiny, bright green, with small, appressed, obtuse teeth, sometimes nearly entire. Flowers white, in umbellate clusters, on slender pedicels 1' to 2' long, appearing with the leaves. Styles 5, distinct. Calyx

persistent. Fruit various in shape, but usually tapering toward the stem. Flesh often granular or gritty. Blooms in April or May, ripens in Sept.

2. *P. Sinénsis*, LINDL. SAND PEAR. CHOKE P. CHINESE OR JAPANESE P. A very rapid-growing tree from China and Japan, specially remarkable for its tough, gritty, nearly spherical fruit. Leaves very dark green, broadly ovate, acuminate, with sharp teeth. Flowers large, appearing before the leaves. Fruit hard, gritty, astringent, depressed at the stem end and resembling a russet apple, but differing in its long stem, and its gritty, astringent taste giving it two of its names, "Sand Pear" and "Choke Pear." It is sometimes used for preserves. Hybridized with No. 1, it has produced the Le Conte and Kieffer varieties.

3. *P. Malus*, L. APPLE. A round-headed, Old World tree, cultivated universally in temperate regions for its varied and valuable fruits. Branches spreading, crooked. Growing branchlets and shoots, and lower surfaces of the leaves grayish-woolly. Leaves soft, dull, downy, ovate or oblong-ovate, cuspidate, irregularly serrate. Flowers white and pink, appearing with the leaves in subumbellate corymbs on short, woolly pedicels. Calyx segments woolly. Fruit varying indefinitely in form and character, but usually depressed at both ends, with a short stem, and always with the calyx lobes persistent. Twenty-two varieties, according to Pliny, were known among the ancient Romans; now they are numbered by hundreds.

4. *P. baccata*, L. SIBERIAN CRAB APPLE. A small, Asiatic tree, with spreading branches, compact head, and smooth, hard, and wiry shoots. Leaves smooth, thin, ovate, acute, finely serrate, on slender petioles as long as the leaves. Flowers pure white, opening with the leaves in clusters, on slender, greenish pedicels 2' to 3' long. Fruit spherical, 3' to 6' in diameter, yellow or red, *losing the calyx lobes before maturity*. Flesh firm, often translucent, never mellow. Many varieties are in cultivation of which some, as the TRANSCENDENT and HYSLOP, are probably hybrids of this species and *P. Malus*. *P. floribunda*, LINDL, the JAPANESE FLOWERING CRAB, an ornamental flowering bush or shrub, is sometimes liable to be confounded with this species; but it has rose-colored and red flower buds, with fruit no larger than peas, and long, acuminate, usually sharply toothed leaves.

5. *P. coronaria*, L. AMERICAN OR WILD CRAB APPLE. A low, bushy tree, 10° to 20° high, with stiff, crooked, rather thorny branches, found in glades and thickets from western N.Y., Pa., and N.J. south to S.C. west to Minn., Kan., and La. Leaves ovate or triangular-ovate, 1' to 3' long, cut-serrate, often prominently lobed or notched, thin, hard, smooth when mature, on smooth, slender, stiff petioles. Flowers rose-colored, 1' to 2' wide, very fragrant, in loose corymbs or cymes of 5 to 10, on smooth pedicels 6'' to 18'' long. Fruit globular, 12'' to 18'' in diameter, greenish-yellow, *with persistent calyx*, fragrant acid, esteemed for preserves. May.

6. *P. Ioénsis*, BAILEY. WESTERN OR PRAIRIE STATES CRAB APPLE. A small tree, of low, flat lands in the Mississippi Valley, resembling No. 5. Leaves oblong or ovate-oval, 1' to 2' long, irregularly and usually bluntly toothed or with right-angled notches and shallow lobes, and white-pubescent beneath. Petioles, pedicels, and calyx also pubescent. Fruit globose or oblong, dull green, with very small, light dots. April, May.

7. *P. angustifolia*, AIT. NARROW-LEAVED CRAB APPLE. A small tree, of glades and thickets from N.J. to Fla. west to Kan. and La., similar to No. 5 in its fragrant, rose-colored flowers, but with lanceolate, oblong-lanceolate or oval, crenate-serrate, or almost entire, thick, shining, dark green leaves 1' to 2' long, on short petioles. *Flowers less than 1' wide. Styles nearly distinct.* Fruit about 1' in diameter. March to May.

8. *P. arbutifolia*, L.f. CHOKEBERRY. A low, branching shrub, 8° to

8° high, common in swamps and moist thickets and woodlands from Me. to Minn., Fla., and Tex. Leaves with midvein glandular on the upper side, oblong-obovate or oval-lanceolate, 1' to 3' long, serrulate-crenulate, smooth above, usually densely tomentous or pubescent beneath, on short petioles. Flowers white or purplish-tinged, 4" to 6" wide, in compound, terminal corymbs, with woolly pedicels and calyx. Fruit globose, about the size of a currant, astringent, *bright red, remaining on the branches till after the fall of the leaves.* May, June. Var. *melanocarpa*, Hook (or *P. nigra*, SARGENT), the BLACK CHOKEBERRY, has broadly ovate leaves and along with the pedicels and calyx nearly smooth, earlier flowers, and *black fruit which falls soon after ripening.*

9. *P. Americana*, DC. AMERICAN MOUNTAIN ASH. A small, slender tree or tall shrub, with smooth, light gray bark, in swamps and mountain woods, from New Eng. to Mich. and south along the mts. to N.C. and Tenn. Leaves odd-pinnate, 6' to 10' long, with a slender, grooved petiole. Leaflets 9 to 17, oblong-lanceolate, acuminate, 2' to 3' long, serrate, smooth, subsessile, the terminal one distinctly stalked. Flowers appearing in May or June after the leaves, small, white, in terminal, compound cymes of 60 to 100, 3' to 4' across. Styles 3 to 5. Pomes small, globous, berry-like, 2" to 3" in diameter, scarlet, ripening in Sept. and remaining on the tree all winter. Often cultivated for ornament.

10. *P. Aucuparia*, GAERTN. EUROPEAN MOUNTAIN ASH. ROWAN TREE. An Old World, ornamental tree, often cultivated in this country, much larger than No. 9, 20° to 40° high, with much larger fruit, 5" to 6" in diameter, oblong, obtuse, and paler leaflets, downy on the under surface. In other respects the two trees are very much alike.

11. *P. Cydonia*, L. (*CYDONIA VULGARIS*, PERS.) QUINCE. A small, bushy tree, 8° to 12° high, of central and eastern Asia, introduced from Europe and cultivated for its fruit. Branches crooked, straggling, slender, thornless. Leaves oval or oblong-obovate, acute with rounded or obtuse base, entire, smooth above, villous-pubescent beneath, 2' to 4' long. Flowers white or light pink, large, 2' wide, solitary, terminal. Styles 5. Ovary 5-celled; the several seeds of each cell covered with a mucilaginous pulp. Fruit large, yellow, downy, globular or pear-shaped; highly prized for marmalade, jelly, and preserves. Its use for marmalade is said to date back at least 2000 years.

12. *P. Japonica*, THUNB. (*CYDONIA JAPONICA*, PERS.) JAPAN QUINCE. A bushy, ornamental shrub, 3° to 6° high, with spreading, spiny branches, from Japan and China, often cultivated for its gorgeous flowers, produced before the leaves in early spring. Leaves smooth, shining, coriaceous, ovate or oblong, acute, sharply serrate. Stipules kidney-shaped. Spines short, straight. Flowers in great profusion on side spurs, nearly sessile, solitary or 2 or 6 together, 2' wide, scarlet-red, but in cultivation varying to white and often double. Fruit very hard, pear-shaped, 1' to 2' long, yellowish-green.

IV. *AMELANCHIER*, MEDIC. JUNE BERRY. Shrubs or small trees, with simple, usually serrate leaves, and white racemed, rarely solitary flowers. Calyx bell-shaped, with 5 narrow, reflexed, persistent lobes. Petals 5, usually oblong, narrowly oblong, or oblanceolate. Stamens many, short. Styles 3 to 5, usually 5. Pome mostly 5-celled, the cells 2-ovuled; but, by the projection of a false cartilaginous partition from the back of each cell, becoming 10-celled, and thus each cell when ripe 1-seeded.

1. *A. Canadensis*, TORR AND GRAY. JUNE BERRY. SERVICE B. SHAD B. A slender tree, 20° to 30° high, with small, spreading branches forming an oblong head, found in rich or dry, open woodlands, from Me. to Fla. west to Minn. and Ark. Leaves ovate or oblong-ovate, acute or acuminate, rounded or somewhat cordate at base, sharply serrate, 1' to 3' long, downy when young, at length very smooth. Flowers in loose, terminal, spreading or drooping racemes, conspicuous in the naked forest in early spring. Petals white, linear or linear-oblong, 6'' to 9'' long. Bracts and stipules silky-ciliate. Fruit globose, about 3'' in diameter, crimson or purple, on elongated pedicels, ripening in June, sweet, edible. Called *Shad Berry* because it ripens about the time the shad ascend the streams. Several varieties occur, usually shrubs, as Var. *oblongifolia*, TORR AND GRAY, and Var. *rotundifolia*, TORR AND GRAY, with *oblong* and *roundish* leaves respectively; both treated by some as distinct species.

2. *A. alnifolia*, NUTT. NORTHWESTERN JUNE BERRY OR SERVICE B. A shrub, 6° to 8° high, occurring in mountainous districts from Mich. to Neb. and westward, with broadly oval, thick leaves, coarsely toothed above the middle, 6'' to 24'' long. Flowers with cuneate, oblanceolate petals 3'' to 8'' long, on short pedicels, in short, dense racemes. Fruit globose, 3'' to 4'' in diameter, dark purple or blue, glaucous, sweet, juicy.

V. *RÒSA*, TOURN. ROSE. Erect or climbing shrubs, with mostly prickly stems, odd-pinnate leaves, stipules usually adnate to the petiole, and showy flowers, either single or in terminal corymbs. Calyx tube urn-shaped, with contracted mouth and 5-cleft limb, becoming fleshy in fruit. Petals 5, in the wild state (greatly multiplied in cultivation), obovate or obcordate, spreading, inserted with the many stamens in the throat of the calyx. Pistils many, hairy, with terminal styles, becoming hispid, bony akenes attached to the inner surface of the calyx tube.

Native species. (a)

Naturalized species. (b)

a. Styles coherent, exserted	No. 1
a. Styles distinct, sepals persistent	No. 2
a. Styles distinct, sepals deciduous	Nos. 3, 4, 5
b. Naturalized in both Northern and Southern States	Nos. 6, 7
b. Naturalized only in the Southern States	Nos. 8, 9

1. *R. setigera*, Mx. CLIMBING OR PRAIRIE R. MICHIGAN R. A vigorous climber, with shoots 10° to 20° long in a season, found on the borders of thickets, prairies, and swamps, from Mich. to Neb. south to Ohio, S.C., Fla., and Tex., and very extensively cultivated and escaped from cultivation from N.J. to Va. Stems long, climbing, smooth, armed with stout, scattered prickles, *but not bristly*, as its specific name (*setigera*) would imply. Leaflets 3 or sometimes 5, ovate, 1' to 3' long, sharply serrate, shining above. Stipules narrow, acuminate, adherent. Petioles, peduncles, and ovate, acute, deciduous sepals glandular. Flowers few in a corymb 2' to 3' wide; petals varying from deep rose-color to white. *Styles cohering in an exserted column*. Fruit globular, smooth. June, July.

2. *R. blanda*, AIT. EARLY WILD R. SMOOTH R. MEADOW R. An erect shrub, 2° to 4° high, with reddish bark, wholly unarmed, or with only a few slender prickles, found in moist and rocky places from New

Eng. to N.J. west to Wis. and Ill. Stipules dilated. Leaflets elliptic to obovate-oblong, obtuse, short-stalked, simply serrate, 12" to 18" long, smooth above, not shining. Flowers pink, 2' to 3' wide, usually in pairs, sometimes solitary or in a small corymb. *Calyx lobes lanceolate, entire, hispid, persistent, and erect on the globose fruit.* June, July.

3. *R. Carolina*, L. SWAMP R. A bushy shrub, with smooth, erect stems, 1° to 7° high, armed with stout commonly hooked prickles, found in the borders of swamps and streams and in low grounds from Me. to Minn. south to Fla. and Miss. Stipules long and narrow. Leaflets 5 to 9, usually 7, very variable but usually elliptical or oblong-lanceolate, 1' to 2' long, acute, *finely serrate*, dull green. Flowers, in leafy corymbs or rarely solitary, 2' to 3' wide; petals varying from red to white. Fruit depressed-globose, about 4" in diameter, and with the peduncle glandular-hispid. The lanceolate calyx lobes, spreading or reflexed, deciduous. June to Aug.

4. *R. humilis*, MARSH. DWARF R. PASTURE R. A bushy shrub, with stems usually low but varying from 6' to 6° high, usually with straight, slender, stipular prickles, growing in dry or rocky soils from Me. to Wis. south to Ga. and La. Our most common wild rose. Stipules narrow. Leaflets 5 to 7, mostly 5, elliptical, ovate or obovate, coarsely serrate, somewhat shining, rather thin. Flowers pale red, 2' to 3' wide, solitary, or 2 or 3 together. Pedicels and calyx glandular, the latter with leafy, lanceolate, often incised, spreading and deciduous lobes. Fruit globose, about 4" in diameter. The species is very variable and much confused with the next.

5. *R. lucida*, EHRR. SHINING R. A bushy shrub, found on the borders of swamps and in moist places from New Eng., N.J., and eastern Pa., nearly allied to, if not a mere variety of, the preceding, with the 5 to 7 leaflets, mostly 5, rather thick, dark green, *smooth and shining above*, and the stipular prickles stout and more or less hooked.

6. *R. rubiginosa*, L. EGLANTINE. SWEETBRIER. A stout, European shrub, 4° to 8° high, introduced and naturalized in fields and waste places from New Eng. to Ga. and westward. Stem smooth, armed with strong, recurved and slender, awl-shaped, weak prickles. Stipules broad. Leaflets 5 to 7, oval or ovate, obtuse, doubly serrate, with densely resinous and aromatic, ferruginous glands beneath. Flowers pink, varying to white, fragrant, mostly solitary on hispid peduncles. Fruit oval or ovoid, orange-red. June, July.

7. *R. canina*, L. DOG R. CANKEE R. A European shrub, 4° to 8° high, with erect or straggling branches often 8° to 10° long, armed with stout, hooked prickles, sometimes absent on the branches, introduced by cultivation and somewhat naturalized in waste places here and there, as in western N.J., the valley of the Del., and in Tenn. Somewhat similar to No. 6, but with broader and glandular stipules, the 5 to 7 leaflets elliptical or ovate, simply serrate, and without aromatic glands. Flowers light pink to white, in clusters of 2 to 4, or sometimes single, and on usually smooth pedicels. Sepals pinnatifid, reflexed, finally deciduous. Fruit ovoid, red, smooth, 6" to 8" long. June, July.

8. *R. lævigata*, Mx. (*R. sinica*, Ait.) CHEROKEE R. A handsome climbing or trailing shrub from southern China, hardy, extensively cultivated for hedges and ornament and naturalized in the Southern States. Stem smooth and polished, with long, slender, green branches armed with very strong, hooked prickles. Leaflets 3, rarely 5, elliptic-ovate to ovate-lanceolate, 18" to 30" long, sharply serrate, coriaceous, shining, evergreen. Stipules free, setaceous, deciduous. Flowers solitary, terminal, white, often 3' wide. Calyx bristly; lobes entire. April.

9. *R. bracteata*, L. MACARTNEY R. A half-evergreen climber from southern China, hardy and cultivated in the Southern States and natural-

ized in La. and Fla. Stems climbing or trailing, with erect branches, armed with stout, hooked prickles. Leaflets 5 to 9, obovate to oval, subserrate, coriaceous, smooth, bright green and shining above, 6" to 24" long. Flowers solitary, terminal, short-stalked, white, 2' to 3' wide. Peduncle and calyx densely tomentose, *the latter subtended by large bracts (bracteata)*. Fruit globous, orange. Varieties with cream-colored to scarlet flowers occur. July.

VI. AGRIMONIA, L. AGRIMONY. Perennial herbs, with interruptedly odd-pinnate leaves, conspicuous stipules, and yellow flowers in slender, spiked racemes. Calyx tube more or less top-shaped, contracted at the throat, armed above with hooked bristles; the 5-cleft limb connivent after flowering. Petals 5. Stamens 5 to 15. Ovaries 2; styles terminal; akenes 2, inclosed in the indurated bur-like calyx tube.

Stem hairy. (a)

Stem smooth or nearly pubescent. (b)

a. Flowers large, 4" to 6" wide. Leaflets 5 to 7, mostly 7	No. 1
a. Flowers small, 3" to 5" wide. Leaflets 9 to 17, narrow	No. 2
a. Flowers small, 2" to 3" wide. Leaflets incisedly few-toothed	No. 3
b. Flowers small, 2" to 3" wide. Leaflets 8 to 9, mostly 5. Stem smooth	No. 4
b. Flowers small, 3" to 5" wide. Leaflets 5 to 11, mostly 7. Stem pubescent	No. 5
b. Flowers small, 2" to 3" wide. Leaflets 8 to 5, mostly 8. Stem pubescent	No. 6

1. A. hirsuta, BICKNELL. TALL HAIRY A. A hairy herb, 3° to 4° high, common in dry, open woods and thickets from Me. to Minn. south to N.C. Root fibrous. Stem tall, hairy, usually branching. Leaflets 5 to 7, mostly 7, elliptic to oval, acute, coarsely serrate with ciliate margin, thin, bright green. Stipules broad, coarsely incised. Minute, interposed leaflets, 2 or 3 pairs in each interval. Flowers 4" to 6" wide, with bright yellow petals twice as long as the reflexed calyx lobes, in simple or branched, spicate racemes 4' to 16' long. Fruit a strongly ribbed, top-shaped bur 3" to 6" long, with spreading, hooked bristles, by which it is caught and carried away on the coats of animals. June to Aug.

N.B.—Our most common species, long regarded as identical with *A. eupatorioides*, the Common Agrimony of Europe, which is now believed to be entirely distinct and not found in this country. Nos. 4, 5, and 6 below were also regarded as merely varieties of Nos. 1 and 2.

2. A. parviflora, AIT. LEAFY OR MANY-FLOWERED A. A very leafy species, 2° to 6° high, in damp thickets or borders of woods from southern N.Y. to Mich. and Mo. south to Ga. and Miss. Root fibrous. Stem densely hirsute below, villous above. *Leaves crowded, 4' to 12' long.* Stipules lacinate, clasping. *Leaflets 9 to 17, narrowly elliptic to lanceolate, acute or acuminate, 1' to 3' long, sharply serrate.* Interposed leaflets, 4 or 5 pairs or fewer in each interval. *Flowers pale yellow, 3" to 5" wide, in erect or spreading, many-flowered racemes 8' to 24' long.* Fruit wide top-shaped, 1" to 2" long, with erect, spreading, and reflexed bristles. July to Oct.

3. A. incisae, TORR AND GRAY. SOUTHERN A. A strictly southern species, 1° to 4° high, of dry, open, and pine woods from N.C. to Fla. and Ala. Stem simple, or with ascending branches above, and with the petioles and lower surfaces of the leaves clothed with a mixture of soft down and long hairs. Leaflets 7 to 9, oblong or obovate, 1' long, coarsely incised with a few recurved or salient teeth; interposed leaflets, 1 or 2

pairs in each interval. Flowers 2'' wide, with 5 stamens, in slender, loose racemes 4' to 16' long. Fruit 2'' long, bell-shaped; bristles erect or ascending. Aug.

4. *A. striata*, Mx. WOODLAND OR SMOOTH A. A smooth herb, 1° to 3° high, of shaded soils or woodland hillsides from Conn. to Ga. and Mo. Stem from a tuberous-thickened root, smooth or nearly so, simple, or with slender branches above. Leaflets 3 to 9, usually 5, thin, obovate, or oblong, 1' to 3' long, obtuse, coarsely crenate-serrate, often cuneate at base. Interposed, minute leaflets, usually only 1 pair in each interval. Stipules lanceolate, incised. Flowers 2'' to 3'' wide, in loose, slender racemes 3' to 6' long. Fruit hemispheric, 1'' to 2'' long, with short, weak, erect or ascending bristles. July to Sept.

5. *A. mollis* (TORR AND GRAY), BRITTON. SOFT A. A downy herb, 2° to 6° high, in woods and on hillsides from Conn. to Mich. and Kan. south to Ga. Stem from a tuberous-thickened root, more or less pubescent, villous or tomentous, as also the racemes. Leaflets 5 to 11, mostly 7, narrowly oblong to obovate, crenate to dentate; interposed minute leaflets, usually only 1 pair in each interval. Stipules lanceolate and entire or broader and incised. Flowers deep yellow, 3'' to 5'' wide, in loose, wand-like racemes 4' to 12' long. Fruit top-shaped, 2'' to 3'' long, with erect or ascending bristles. July to Oct.

6. *A. pumila*, MUHL. SMALL-FRUITED OR DWARF A. A small, slender herb, 1° to 2° high, found in dry, open woods from Pa. to Ky. south to Fla. and La. Stem from a tuberous-thickened root, erect or ascending, mostly simple, pubescent. Leaflets 3 to 5, often only 3, small, elliptic to obovate, 1' long, terminal one cuneate, obtuse or acute, crenate or crenate-dentate; interposed minute leaflets, if any, usually 1 pair. Stipules small. Flowers 2'' to 3'' wide, in very loose racemes 4' to 20' long. Fruit top-shaped, 2'' long; bristles ascending or erect. Aug.

VII. SPIRÆA, L. SPIRÆA. Shrubs or perennial herbs, with simple or pinnately compound, mostly stipulate leaves, and white or rose-colored, sometimes dioecious flowers in terminal or axillary corymbs or panicles. Calyx short, open, 5-cleft, persistent. Petals 5, roundish. Stamens 10 to 50, exserted. Ovaries 5 to 8, follicular, not inflated, 1-valved, 1 to several-seeded. Seeds linear.

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| § 1. <i>SPIRÆA</i> proper. Shrubs with simple leaves | Nos. 1 to 5 |
| Shrubs with pinnate leaves | No. 6 |
| § 2. <i>ULMÆRIA</i> . Perennial herbs with perfect flowers | Nos. 7 to 9 |
| § 3. <i>ARDNUS</i> . Perennial herbs with dioecious flowers | No. 10 |

1. *S. salicifolia*, L. AMERICAN MEADOWSWEET. An erect, nearly smooth shrub, 2° to 4° high, in swamps and wet or low grounds from Me. to Dak. south to Ga. and Mo. Stem slender, purplish, brittle. Leaves oblong, obovate, or lanceolate, 1' to 2' long, simply or doubly, sharply serrate. Flowers white or flesh-colored, with conspicuous stamens in a crowded, terminal panicle. Follicles smooth. June to Aug.

2. *S. tomentosa*, L. HARDHACK. STEEPLE BUSH. A shrub, 2° to 3° high, with woolly-pubescent, usually simple stem, common in low, wet grounds and meadows from Me. to Minn. south to Ga. and Kan. Leaves ovate-lanceolate or ovate, 1' to 2' long, unequally serrate, smooth, and dark green above, whitish-woolly beneath. Flowers pink, rarely white,

in dense, slender, pyramidal, terminal panicles. Its common names refer respectively to the hardness of the stem to the scythe of the hay-maker, and to the steeple-like panicle. July to Sept.

3. *S. corymbosa*, RAF. CORYMBED SPIREA. A nearly smooth shrub, 1° to 2° high, with simple or slightly branched stem, ranging from the mts. of N.J. and Pa. to Ga. west to Ky. and Mo. Leaves broadly ovate, incised and unequally serrate, especially toward the apex, 2' to 3' long. Flowers white or rose-colored, in large, flat, compound, terminal corymbs. May, June.

4. *S. Cantoniensis*, LOUR. (*S. REEVESIANA*, LINDL.) REEVES'S SPIREA. A smooth, evergreen shrub, 3° to 4° high, with slender, arching branches, from China and Japan, hardy in the Southern States, but only half hardy in the Northern. Leaves simple, rhombic-lanceolate, 3-lobed, deeply toothed, 1' to 2' long, dark green above, pale bluish-green beneath. Flowers white, in dense, terminal umbels. Sepals upright in fruit. Pods with spreading styles. A more tender variety has double flowers.

5. *S. hypericifolia*, L. ITALIAN MAY. ST. PETER'S WREATH. A smooth, Old World, ornamental shrub, 3° to 6° high, with slender, arching, or upright branches, obovate-oblong, obtuse, nearly entire leaves tapering to a very short petiole, and small, white flowers in small, sessile umbels or pedunculate corymbs. Pedicels smooth or pubescent, as long as the leaves, 9'' to 18'' long. Petals roundish, usually longer than the stamens. Several varieties are cultivated. May.

6. *S. sorbifolia*, L. MOUNTAIN-ASH-LEAVED SPIREA. A very hardy, ornamental shrub, 3° to 4° high, from Siberia, common in old gardens and now escaping from cultivation in the Middle States. Stem stout, with rough bark and straggling branches. Leaves odd-pinnate, with 17 to 21 lanceolate, doubly and sharply serrate leaflets, resembling those of the Mountain Ash, as indicated by the specific name. May.

7. *S. Ulmària*, L. ENGLISH MEADOWSWEET. QUEEN OF THE MEADOW. An Old World, ornamental, perennial herb, 2° to 4° high, with erect, furrowed, branched stem, interruptedly pinnate leaves, usually white downy beneath, and many small, yellowish-white, fragrant flowers, sometimes double, in a very compound cyme, 2' to 6' in diameter, at the tops of the stems. Leaves 3 to 7-foliolate, with minute, interposed leaflets, lateral leaflets sessile, opposite, ovate-lanceolate, terminal one much larger, palmately 3 to 5-lobed, all doubly serrate. Stipules leafy, half-ovate, toothed. Pods about 10, indehiscent, 1-seeded, spirally twisted. June to Aug.

8. *S. lobata*, JACQ. QUEEN OF THE PRAIRIE. A smooth perennial, 2° to 8° high, of meadows and prairies from western Pa. to Mich. and Iowa south to Ga. and Ky., and escaped from cultivation in places farther east. Leaves interruptedly pinnate, terminal leaflet very large, 7 to 9-parted, the lobes incised and toothed, lateral leaflets of 3 to 5 lanceolate, unequally serrate or incised lobes. Stipules reniform, serrate. Flowers 4'' to 5'' wide, deep rose-colored, fragrant, in a large, cymously-branched panicle on a long, naked peduncle. Petals and sepals often in 4's. Capsules 6 to 8, smooth, 1-seeded. June, July.

9. *S. Filipendula*, L. DROPWORT. A smooth, ornamental, European perennial, often cultivated, with long, fibrous and tuberous roots, erect, grooved stems, 1° to 3° high, and interruptedly pinnate, mostly radical leaves 4' to 10' long. Leaflets many, sessile, oval or lanceolate, deeply cut-serrate, terminal one 3-lobed. Stipules of the few small stem leaves toothed. Flowers 5'' to 9'' wide, white or rosy outside, in loose, panicked cymes on long, slender, terminal peduncles. Capsules about 12, pubescent. June.

10. *S. Aruncus*, L. GOAT'S BEARD. A tall, smooth perennial, with long-petioled, 2 to 3-pinnate leaves, and minute, whitish, diœcious flowers,

in rich woods from N.J. and Pa. west to Iowa and Mo. and south in the mts. to Ga. and Ky. Leaflets thin, ovate-lanceolate, acuminate or acute, sharply and doubly serrate, stalked or sessile. Stem slender, erect, 3° to 7° high, somewhat branched. Flowers very numerous, arranged in long, compound panicles of dense, slender, erect or spreading spikes. Stamens many. Pistils usually 3. Follicles short, smooth, usually 2-seeded. May to July.

VIII. PHYSOCÁRPUS, MAXIM. Shrubs, with simple, palmately-lobed leaves, and white flowers in terminal umbel-like corymbs; closely allied to, and formerly included in, *Spiræa*, from which it differs mainly in its *2-valved, inflated pods and roundish, shining seeds*.

1. *P. opulifólius*, MAXIM. (*SPIRÆA OPULIFOLIA*, L.) NINEBARK. A shrub, 3° to 10° high, with long, spreading, recurved branches, and loose bark peeling off in many thin layers, common along streams and in rocky places from New Eng. to Dak. south to Ga. and Kan., and often cultivated. Leaves smooth, on slender petioles, roundish, palmately 3 to 5-lobed, cordate, truncate or rounded at base, 1' to 3' long, doubly serrate or irregularly crenate-dentate. Flowers white or purplish, in roundish, peduncled, terminal corymbs 2' to 3' wide, on slender, smooth or pubescent pedicels. Pods 3 to 5, 2 to 4-seeded, *inflated*, diverging, twice as long as the calyx, *smooth, purple, shining, conspicuous, ornamental*. June.

IX. GILLÉNIA, MÖENCH. INDIAN PHYSIC. Perennial herbs, with nearly sessile, trifoliolate leaves, and white or pinkish flowers in loose, terminal, corymbose panicles. Calyx tubular, narrowed at the throat, 5-cleft, persistent. Petals 5, linear-lanceolate, very long, unequal, convolute in the bud. Stamens 10 to 20, very short, included. Follicles 5, 2-valved, 2 to 4-seeded. Only two species known and those confined to the eastern U.S.

1. *G. trifoliáta*, MÖENCH. BOWMAN'S ROOT. A handsome, erect, branching, nearly smooth perennial, 2° to 8° high, common in woodlands from N.J. and N.Y. to Mich. south to Ga. and Mo. Stipules awl-shaped, 2'' to 4'' long, entire. Leaflets ovate-oblong, acuminate, cut-serrate, thin, 2' to 3' long. Flowers few, on slender pedicels, the white or rose-colored petals 5'' to 8'' long, calyx reddish. Pods pubescent. Roots reputed to be tonic, cathartic, or emetic, according to the dose. May to July.

2. *G. stipulácea*, NUTT. AMERICAN IPECAC. A perennial, found in woods from western N.Y. and Pa. to southern Ind., Kan., and Ind. Terr. south to Ala. and La., very similar to No. 1, and with the same reputed properties in the root. It differs in having its *leaflets lanceolate and deeply incised*; in the lower leaves, pinnatifid, and its *stipules, 4'' to 12'' long, broad, ovate, acute, doubly incised and leafy*. Flowers also fewer and more frequently pink. June, July.

X. RÚBUS, L. BRAMBLE. Perennial herbs or shrubs, with lobed or 3 to 7-foliolate leaves, stipules adnate to the petiole, white or reddish flowers, and often edible fruit. Calyx spread-

ing, deeply 5-parted, bractless, persistent. Petals 5, deciduous. Stamens numerous. Ovaries many, ovules 2, 1 abortive. Akenes pulpy, drupe-like, collected on a convex or elongated, dry or pulpy receptacle, into an aggregate fruit, popularly known as a berry. Stems usually biennial and prickly. Some of the species are very variable and perplexing and somewhat confused by authors.

§ Fruit not separating from the fleshy receptacle — BLACKBERRIES.

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|---|-------------|
| Stems erect, ascending or recurved, with stout prickles | Nos. 1 to 8 |
| Stems trailing or procumbent, with small prickles or none | Nos. 4 to 6 |

§ Fruit separating from the dry or spongy receptacle — RASPBERRIES.

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|---|--------------|
| Leaves simple, large, palmately lobed | No. 7 |
| Leaves compound, stems without prickles, herbaceous | No. 8 |
| Leaves compound, stems prickly, shrubby | Nos. 9 to 13 |

1. *R. villosus*, AIT. COMMON OR HIGH BLACKBERRY. A shrub, with tall, slender, branching, curving stems, 3° to 6° high, armed with stout, recurved prickles, common in the borders of thickets and in dry soils from New Eng. to Fla. and Ark. Stipules lanceolate or linear. Leaves 3-foliate or pedately 5-foliate. Leaflets ovate or oblong, 2' to 4' long, pointed, unequally and sharply serrate, hairy, and glandular. Petioles prickly. Racemes many-flowered, leafless, with short bracts. Petals white, obovate-oblong, spreading, much longer than the acuminate sepals, appearing in May and June. Fruit varying from oblong, 6'' to 12'' long, to nearly globular, black, sweet; drupelets, small, closely packed; ripe in July and Aug. Var. *frondosus*, TORR. AND GRAY, with the flowers corymbed, the bracts leafy, and the petals roundish, is more common in the North. Var. *humifusus*, TORR. AND GRAY, with smaller and trailing stems, smaller leaves, and fewer flowers, occurs more in the South, where it runs into No. 6.

2. *R. Alleghaniensis*, PORTER. MOUNTAIN BLACKBERRY. A species found mostly in high altitudes from N.Y. to Pa. and possibly Va., nearly allied to the preceding. It has more slender stems, narrower leaflets and more slender fruit, the latter 8'' to 14'' long, 3'' to 4'' thick, rather dry and spicy in flavor. Flowers May to July. Fruit Aug. to Sept.

3. *R. cuneifolius*, PURSH. SAND BLACKBERRY. An erect shrub, 1° to 8° high, found in sandy soils from southern Conn. to Fla. west to Mo. and La. Stem armed with stout, straight or recurved prickles. Young branches, petioles, and lower sides of the 3-foliate leaves densely pubescent or whitish-woolly. Stipules linear. Leaflets, rarely 5, wedge-obovate, 1' to 2' long, dentate above the middle, entire below, thick, rugose. Peduncles with 2 to 3 white or pinkish flowers 1' wide; petals much longer than the calyx, appearing in May and June. Fruit roundish, often 1' long, juicy, agreeable; drupelets few and loose. Ripe in July and Aug.

4. *R. hispidus*, L. RUNNING SWAMP BLACKBERRY. A slightly woody, creeping plant, with slender, prostrate stems beset with stiff, prickly bristles, very common in swamps, low woods, and wet, grassy grounds from Me. to Minn. south to Ga. and Kan. Branches erect or ascending, 4' to 12' high. Leaflets mostly 3, rarely 5, obovate, 1' to 2' long, obtuse, coarsely serrate toward the apex, entire toward the base, nearly sessile, thick, firm, smooth, shining, persistent through the winter. Peduncles several-flowered, leafless, often bristly. Flowers small, petals white, obovate, twice as long as the ovate sepals. Fruit small; drupelets few, dark red or purplish, sour, ripe in July.

5. *R. Canadensis*, L. **LOW BLACKBERRY. DEWBERRY.** A trailing, somewhat prickly shrub, several feet long, common in dry fields from Me. to Minn. south to Va. and Kan. Branches erect or ascending, 4' to 10' long. Leaves petioled. Leaflets 3, or pedately 5 to 7, nearly sessile, elliptical or ovate-lanceolate, 12" to 18" long, pointed, unequally cuteserrate, nearly smooth, light green, thin. Flowers few, racemed with leafy bracts, sometimes solitary, 1' wide, in May. Petals white, obovate. Fruit black, 1' long, ripening in July and Aug.

6. *R. trivialis*, Mx. **LOW-BUSH BLACKBERRY. SOUTHERN DEWBERRY.** A bristly and very prickly, trailing shrub, with rooting runners, found in dry, sandy soils from Va. to Mo. south to Fla. and Tex. Leaflets 3, or pedately 5, narrowly ovate to oblong, acute or obtuse, sharply or bluntly serrate, 1' long, smooth, or nearly so, above, coriaceous, partly persistent. Petioles, midribs, and 1 to 5-flowered peduncles armed with many stout prickles. Flowers white, with obovate petals twice as long as the ovate sepals, appearing in March or April. Fruit oblong, black, well-flavored, ripe in May.

N.B.—A very variable and perplexing species; the same plant sometimes having large, broad leaves on the sterile young shoots, smaller ones on the fruit-bearing stems which remain through the winter, and a third form, small leaves appearing with or before the flowers. The size of the flowers also and the thickness and length of the stems vary greatly, the latter sometimes 40° to 50° long, and 1 in diameter.

7. *R. odoratus*, L. **PURPLE-FLOWERING RASPBERRY.** An erect or reclining, unarmed, branching shrub, 3° to 5° high, with large, palmately lobed, simple leaves, and large, showy flowers, common in rich upland and rocky woods from Me. to Mich. south to Ga. and Tenn. Leaves, on petioles 2' to 3' long, broadly ovate in outline, 4' to 8' wide, 3 to 5-lobed, with cordate base and acuminate, finely toothed lobes, the middle one usually the longest. Flowers conspicuous, 2' wide, with rounded, rose-purple petals, 100 to 200 whitish stamens, and long, slender-pointed sepals, in terminal corymbs or panicle clusters. Branches, peduncles, pedicels, and calyx clothed with glandular, clammy hairs. Fruit red, broad, thin, depressed-hemispherical, edible but insipid. Flowers and fruit together. June to Aug.

8. *R. triflorus*, RICHARDSON. **DWARF RASPBERRY.** A perennial, with an annual or herbaceous, smooth, reddish, slender stem unarmed, trailing or ascending, 1° to 2° long, found in swamps and moist woods from Me. to N.J. and Pa. west to Iowa and Minn. Leaves on slender petioles 1' to 2' long. Leaflets 3, or pedately 5, rhombic-ovate or ovate-lanceolate, 1' to 2' long, acute at base and apex, lateral ones sessile, terminal one stalked, all coarsely and doubly serrate, thin. Peduncles terminal, slender, bearing in May 1 to 3 flowers 4" to 6" wide. Petals white, 5 to 7, erect, rather longer than the reflexed sepals. Fruit small, dark red, acid, ripe in Aug. Drupelets few, large.

9. *R. occidentalis*, L. **BLACK RASPBERRY. THIMBLEBERRY.** A strong, erect, very glaucous bush, 4° to 8° high, with tall, slender, biennial, recurved stems armed with a few small, recurved prickles, but no bristles, common in thickets, rocky fields, and clearings from Canada to Ga. and Mo. Leaves long-petioled. Leaflets mostly 3, rarely 5, ovate, acuminate, coarsely and doubly serrate, white-downy beneath, 2' to 3' long. Flowers mostly in corymb, usually terminal clusters; sometimes scattered and solitary. Petals white, erect, shorter than the spreading, whitish-woolly, long-pointed sepals, appearing in May and June. Fruit hemispherical, purplish-black, rarely yellow or whitish, of excellent flavor, ripe in July. The original of many cultivated forms as the *Tyler*, *Palmer*, *Ohio*, *Gregg*, etc.

10. *R. strigosus*, Mx. **AMERICAN RED RASPBERRY.** A bristly, bushy shrub, found in thickets, neglected fields, or rocky places from Me. to Minn. and Mo. south along the mts. to N.C. Stems biennial, branching, 3° to 5°

high, somewhat glaucous, *without prickles, or only a few weak ones*, but *clothed, as also the petioles, peduncles, etc., with stiff, straight bristles*, often glandular tipped. Leaflets 3 to 5, oblong-ovate or oval, pointed, sharply and irregularly cut-serrate, 1' to 3' long, whitish-downy beneath; lateral leaflets sessile. Flowers 4'' to 6'' wide, in loose, terminal or axillary racemes, or panicles, on slender pedicels, May to July. Petals white, ascending or erect, as long as the spreading sepals. Fruit oblong-hemispheric, light red, well flavored, ripe July to Sept. The parent of many cultivated red raspberries, as the *Marlboro*, *Cuthbert*, *Golden Queen*, etc.

11. *R. neglectus*, PECK. PURPLE RASPBERRY. A bushy shrub, of the same range and habitat as the two preceding, often growing with them and apparently a hybrid between them, but by some regarded as a distinct species. Its characteristics are intermediate between those of Nos. 9 and 10; as, *stems somewhat bristly and somewhat prickly*; *fruit dark red*. The parent of many garden varieties, as the *Shaffer*, *Columbian*, *Addison*, etc.

12. *R. idæus*, L. EUROPEAN OR GARDEN RASPBERRY. An Old World shrub, known to the Romans before the Christian era, and cultivated by them as far back as the fourth century; long cultivated in American gardens in many varieties, but now superseded by varieties of No. 10 as better adapted to our climate. Stems stout, stiff, nearly straight, whitish, with nearly straight, slender prickles. Leaves usually more or less wrinkled, thicker and whiter beneath than No. 10. Shoots, petioles, pedicels, and calyx finely pubescent. Leaves 3 to 5-foliolate; leaflets broad-ovate or rhomboidal, 2' to 4' long. Flowers white, in loose, terminal clusters. Fruit red or yellowish, ripening all summer.

XI. DALIBÁRDA, L. A low, perennial herb, with slender, tufted, and creeping stems, simple, undivided leaves, and white flowers on scape-like peduncles. Calyx inferior, 5 to 6-parted, spreading, 3 of the segments larger and toothed, persistent. Petals 5, sessile, soon falling. Stamens many. Styles 5 to 10, long, deciduous. Ovaries 5 to 10, becoming nearly dry, akene-like drupelets. A monotypic genus of northeastern U.S. and Canada.

1. *D. repens*, L. A shy and modest-looking plant, with foliage suggesting a stemless violet, common in shady woods from Me. to Minn. south to southern N.J., Pa., Ohio, and Mich. Stems 2' to 12' long, pubescent. Leaves roundish-cordate, crenate, downy on both sides, 1' to 2' wide, on slender petioles 2' to 3' long. Flowers 4'' to 5'' wide, on peduncles 2' to 5' long. Petals obovate, longer than the sepals, which come together and inclose the drupelets. June to Aug.

XII. WALDSTEINIA, WILLD. Low, perennial, creeping, strawberry-like herbs, with long-petioled, simple or compound leaves, rather large, membranous stipules, and yellow flowers. Calyx with top-shaped tube and 5-cleft limb, with or without 5 bractlets. Petals 5, obovate. Stamens many. Akenes 2 to 6, on a dry receptacle.

1. *W. fragarioides*, PRATT. BARREN OR DRY STRAWBERRY. A stemless herb, of hilly woods from New Eng. to Ga. west to Ind., Mich., and

Minn. Rootstock thick, scaly. Leaves 3-foliolate, on petioles 3' to 6' long. Leaflets broadly wedge-shaped, cut-toothed, 1' to 2' long, sessile, dark green, shining. Stipules ovate-lanceolate. Flowers 4" to 6" wide, with 5 to 10 petals, in corymbs of 3 to 6, on bracted scapes as high as the leaves. May, June.

XIII. GEUM, L. AVENS. Perennial herbs, with pinnately divided leaves and yellow, white, or purple flowers. Calyx persistent, bell-shaped, deeply 5-cleft, usually with 5 alternate, smaller, and exterior bractlets. Petals 5. Stamens many. Akenes many, crowded on a dry, conical or cylindrical receptacle, and tipped with long, persistent, hairy or smooth, straight or jointed styles.

Flowers purple	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	No. 1
Flowers yellow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	No. 2
Flowers white or whitish	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nos. 3, 4

1. *G. rivale*, L. **PURPLE OR WATER AVENS.** A pubescent herb, with nearly simple stems, 1° to 2° high, growing in swamps and wet meadows from Me. to N.J. west to Dak. and Kan. Rootstock woody, creeping. Radical leaves interruptedly pinnate, tending to lyrate, 4' to 6' long; terminal leaflet or lobe large, rounded, lobed, and toothed. Stipules ovate. Stem leaves 1 to 3, subsessile, 3-foliolate or 3-lobed. Flowers terminal, few, nodding, subglobose, 9" to 12" wide. *Petals obcordate, clawed, erect, purplish-orange*, as long as the erect or spreading, brownish-purple calyx lobes. Styles jointed and bent in the middle, the upper joint plumose. *Head of fruit erect, stiped.* May to July.

2. *G. strictum*, AIT. **YELLOW AVENS.** A coarse, rather hairy herb, of wet meadows or low grounds from Me. to N.J. west to Dak. and Kan. Stem 3° to 5° high, branched above. Root leaves interruptedly pinnate, 5' to 8' long, tending to lyrate, the terminal leaflet ovate or cuneate; leaflets wedge-obovate. Stem leaves 3 to 5-foliolate, rhombic-ovate, toothed. Flowers in panicles, with *golden-yellow, roundish petals* exceeding the reflexed calyx lobes. Stipules large and deeply cut. *Receptacle downy.* Styles bent and jointed near the middle, the upper part deciduous, the lower persistent and hooked. *Head of fruit sessile.* July, Aug.

3. *G. album*, GMELIN. **WHITE AVENS.** A smooth or softly pubescent herb, common in borders of woods and shady places from Me. to Ga. west to Minn. and Mo. *Stems erect, slender*, 2° to 3° high, branched above. Root leaves 3 to 5-foliolate, or simple, with minute leaflets below it on the long petiole. Stem leaves short-petioled or sessile, ternately divided or lobed, or merely toothed. Stipules small. *Peduncles long, slender, with ascending or spreading hairs.* Flowers with *small, white, obovate petals equaling the reflexed calyx lobes.* Styles jointed and bent, as in No. 2. *Head of fruit sessile. Receptacle densely white-bristly.* June to Aug.

4. *G. Virginianum*, L. **ROUGH AVENS.** A coarse herb, of low grounds and wet thickets from Me. to Pa. and southward in the Alleghanies west to Minn. and Mo. Similar to No. 3, but with a bristly-hairy, stout stem, the *peduncles short and stout and clothed with reflexed, stiff hairs*, and the *inconspicuous, greenish-white petals shorter than the calyx lobes.* *Receptacle also smooth or nearly so.* Root leaves and lower stem leaves pinnate, but various. Upper stem leaves mostly ternate or 3-parted; the leaflets or lobes incised. May to July.

XIV. FRAGARIA, L. STRAWBERRY. Small, perennial herbs, with runners mostly instead of stems, tufted, petioled, 3-foliolate, stipulate, radical leaves, and clustered white flowers on naked scapes or solitary ones on slender, axillary peduncles. Calyx flat, deeply 5-cleft, with 5 exterior, alternate bractlets. Petals obovate. Stamens many. Styles many, lateral. Akenes many, smooth, dry, minute, attached to the large, convex or globous, deciduous, pulpy, usually red receptacle.

- § 1. **FRAGARIA** proper. Plants stemless, with runners, white flowers, entire bractlets. (a)
 a. Akenes imbedded in the fruit Nos. 1, 2, 3
 a. Akenes on the surface of the fruit No. 4
 § 2. **Duchesnia.** Plants with trailing stems, yellow flowers, 3-lobed bractlets No. 5

1. **F. Virginiana, DUCHESNE.** VIRGINIA OR AMERICAN WILD STRAWBERRY. A pubescent, stemless perennial, common in woods and fields from Me. to Minn. south to Fla. and La. Petioles rather stout, villous-pubescent, 2' to 6' long. Leaflets oval or obovate, obtuse, coarsely dentate, subsessile, rather thick and firm. Scapes less hairy than the petioles and usually shorter. Calyx lobes erect after flowering, spreading in fruit or connivent over a sterile receptacle. *Akenes imbedded in pits in the globous or ovoid, light scarlet fruit.* Long ago domesticated and the parent of some old-time garden varieties. May, June.

2. **F. Canadensis, Mx.** NORTHERN WILD STRAWBERRY. A stemless perennial, found in fields and meadows of New Eng. and N.Y. north of the Catskills, with *more slender petioles, scapes, and pedicels* and narrower leaflets and fruit than in No. 1, but in most other points the same. May to July.

3. **F. Chilensis, DUCHESNE.** GARDEN STRAWBERRY. A stemless perennial from Chile, with stout petioles and peduncles, and thick, dark-colored leaves, more or less glossy above and bluish-white beneath, the original of most of our present varieties of garden strawberries. Leaflets blunt-toothed. Peduncles short, bearing the flowers beneath the leaves. Fruit large, dark-colored, with a very large calyx and a musky flavor. Var. *ananassa*, or PINE STRAWBERRY, of taller growth, with larger, thinner, and usually lighter green leaves and larger fruit, is the common Garden Strawberry.

4. **F. vesca, L.** ENGLISH WILD STRAWBERRY. WOOD STRAWBERRY. A stemless, European species, formerly cultivated in our gardens and now naturalized in fields and by roadsides in the Eastern and Middle States. It differs from No. 1 mainly in *having its akenes borne on the surface, not imbedded in pits, of the conical or hemispherical fruit, its peduncles usually longer than the leaves*, displaying the fruit above them, and the *calyx lobes in fruit spreading or reflexed.* Var. *Americana*, PORTER, has slender, nearly smooth petioles and peduncles, and thinner and narrower leaflets, smaller flowers, and more elongated fruit.

5. **F. indica, L.** INDIAN STRAWBERRY. An ornamental, trailing, perennial herb from Upper India, escaped from cultivation as far north as Pa. and N.Y. and very common in the southeastern States. Stems trailing, pubescent, rooting at the nodes. Calyx with enlarged, leafy, 3-lobed bractlets exceeding the sepals. Petals yellow. Fruit insipid, red, globous, on solitary, axillary peduncles. Leaflets obovate, crenate-dentate. Flower and fruit throughout the summer.

XV. POTENTILLA, L. Herbs, or rarely shrubs, with stipulate, palmately or pinnately compound leaves, and yellow, white, rarely red or purple, cymose or solitary flowers. Calyx persistent, with a concave tube, 5, or rarely 4 lobes, and as many alternate, exterior bractlets. Petals 5, rarely 4, usually roundish. Stamens many. Akenes many, collected into a head on a dry, usually pubescent receptacle. Styles terminal or lateral, deciduous.

Leaves palmately 5-foliolate. Flowers yellow	No. 1 to 3
Leaves palmately 3-foliolate. Flowers yellow or white	No. 4, 5
Leaves pinnate. Shrubs	No. 6
Leaves pinnate. Herbs, with axillary, solitary flowers	No. 7
Leaves pinnate. Herbs, with cymose flowers	No. 8

1. *P. Canadensis*, L. CINQUEFOIL. FIVE-FINGER. A villous-pubescent, tufted, perennial herb, with slender, decumbent or prostrate stems, often becoming runners, 5-foliolate, or rarely 3 to 4-foliolate, petiolate leaves, and solitary, axillary, yellow flowers, common in dry soils from Me. to Minn. south to Ga. and Ind. Terr. Leaflets obovate or oblanceolate, 6'' to 12'' long, cut-dentate toward the apex, entire toward the base. Stipules lanceolate, entire, or somewhat toothed. Flowers 3'' to 6'' wide, on long peduncles. Petals broadly oval, longer than the narrow, acute calyx lobes or than the still longer and narrower bractlets. A variable plant, resembling a strawberry. April to July.

2. *P. argentea*, L. SILVERY OR HOARY CINQUEFOIL. A tufted, whitish-woolly, perennial herb, with procumbent or ascending stems, 4' to 12' long, paniculately branched above, with palmately 5-foliolate leaves and corymbed, yellow flowers, found in dry soils from Me. to Dak. south to Md., Ind., and Kan. Leaflets sessile, oblong, wedge-shaped, 5'' to 10'' long, entire toward the base, pinnatifid toward the apex, smooth and green above, silvery-canescens beneath. Flowers 2'' to 4'' wide. June to Sept.

3. *P. récta*, L. A coarse, hairy, perennial, European herb, with a rather stout, erect stem, 2° to 3° high, palmately 5 to 7-foliolate leaves, and rather large, bright yellow flowers in terminal cymes, cultivated in old gardens and somewhat escaped and naturalized in waste places from N.Y. to Va. west to Mich. Leaflets oblong to oblanceolate, coarsely serrate, green on both sides, 1' to 3' long. Flowers many, 6'' to 9'' wide, in expanding cymes. Akenes rugose. June to Sept.

4. *P. Norvégica*, L. NORWAY CINQUEFOIL. A hairy annual or biennial herb, with a stout, erect stem, 1° to 2° high, dichotomously branching above, leafy stipules, palmately 3-foliolate leaves, and yellow flowers, found in dry soils, and often as a weed in cultivated ground, from Me. to S.C. west to Dak. and Kan. Lower leaves petioled; upper ones sessile. Stipules large, ovate or lanceolate, toothed or entire. Leaflets obovate or elliptical, dentate-serrate, green on both sides, 1' to 2' long. Flowers 3'' to 6'' wide, in terminal, leafy-bracted, usually close cymes. Petals obovate, shorter than the calyx lobes and bractlets. June to Sept.

5. *P. tridentata*, Ait. THREE-TOOTHED CINQUEFOIL. A small, tufted perennial, 4' to 10' high, with rather woody base, palmately 3-foliolate leaves, and white flowers, found along the shores of the Great Lakes and of the New Eng. coast and on high altitudes from New Eng. to N.C., and sometimes cultivated. Leaflets obovate-wedge-shaped, entire, 6'' to 12''

long, with 3 large teeth at the apex, dark green and shining above, coriaceous. Flowers 3'' to 5'' wide, in terminal cymes. Petals obovate, longer than the calyx lobes. June to Aug.

6. *P. fruticosa*, L. SHRUBBY CINQUEFOIL. A bushy shrub, with erect or ascending, branching stems, 1° to 4° high, shreddy bark, pinnately 5 to 7-foliolate bluish-green leaves, and large, yellow flowers, found in wet places from New Eng. to Minn. south to N.J. and Ill. Leaves petioled. Leaflets oblong-lanceolate or oblong-linear, 6'' to 12'' long, sessile, silky, with entire and revolute margins. Flowers terminal, in dense cymes or solitary, 10'' to 16'' wide. Petals nearly round, longer than the calyx lobes and bractlets. Akenes hairy. June to Sept.

7. *P. Anserina*, L. SILVERWEED. GOOSE TANSY. A tufted, perennial herb, spreading by many-jointed, slender runners 1° to 3° long, with pinnately compound leaves and large, yellow flowers, found in brackish marshes and wet shores and meadows from New Eng. to N.J. and from northern Ind. to Minn. Leaves radical, pinnate, 3' to 18' long. Leaflets 7 to 25, oblong or oblanceolate, sharply serrate, the lower ones usually smaller, and still other minute ones interspersed, all smooth above and canescent beneath. Flowers 8'' to 12'' wide, solitary, on erect, slender, axillary peduncles as long as the leaves. Petals broadly obovate, entire or emarginate, longer than the calyx lobes and bractlets. May to Sept.

8. *P. arguta*, PURSH. TALL OR GLANDULAR CINQUEFOIL. A coarse, glandular-villous, perennial herb, with a stout, erect, usually simple stem, 1° to 4° high, clammy above, pinnately compound leaves, and many white or cream-colored flowers in dense, terminal cymes, found on rocky hills from Me. to Dak. south to N.J., Ill., and Kan. Radical leaves 1° or more long, long-petioled, 7 to 9-foliolate; stem leaves short-petioled or sessile, 3 to 7-foliolate. Leaflets broadly oval or ovate, cut-serrate, downy beneath, crowded. Flowers 6'' to 8'' wide, on short pedicels. Petals roundish, longer than the ovate, acute calyx lobes. Stamens 25 to 30, on a thick, glandular disk. June, July.

ORDER 37. CALYCANTHACEÆ—CALYCANTHUS FAMILY

Shrubs, with opposite, entire, exstipulate, simple leaves, and terminal or axillary, solitary flowers whose numerous, colored sepals and petals, imbricated in several series, are undistinguishable in form or color. Sepals and petals united below into an obconical cup. Stamens several or many, short, inserted within the petals, the inner ones often sterile. Pistils several or many, inclosed in the calyx tube, attached to its base and inner face and becoming 1-seeded akenes in a fruit resembling a rose hip. Seeds without albumen. Cotyledons convolute.

Besides the four American species given below, the order embraces only two other species, from China and Japan, with yellow flowers, and cultivated for ornament in this country, both assigned by Lindley to the genus *Chimonanthus*.

I. CALYCÁNTHUS, L. Aromatic shrubs, with short-petioled leaves, and large, brownish-purple or reddish flowers. Sepals and petals thick, oblong-lanceolate or linear. Otherwise as in the family.

1. *C. flóridus*, L. CAROLINA ALLSPICE. SWEET-SCENTED OR STRAWBERRY SHRUB. A branching shrub, 3° to 8° high, with pubescent branchlets, petioles, and peduncles, found in rich soils from Va. to Ga., Ala., and Miss., and very common in cultivation. Leaves oval or ovate, obtuse, acute, or acuminate, slightly hairy above, densely so with brown hairs beneath, 3' to 5' long. Flowers dark reddish or chocolate-brown, solitary and terminal, on very short, leafy branches, 1' to 2' wide, fragrant, when crushed, with the odor of strawberries. Sepals and petals linear-lanceolate, acutish or blunt, 6'' to 8'' long. Fruit rare, oblong-obovoid, 18'' to 30'' long, finely tomentose, ribbed. April to Aug.

2. *C. lævigátus*, WILLD. (*C. FERTILIS*, WALT.) SMOOTH OR FERTILE STRAWBERRY SHRUB. A branching shrub, 3° to 6° high, with *smooth or nearly smooth branchlets, petioles, and peduncles*, found in the mts. of southern Pa. and southward along the Alleghanies to Ga. Leaves oblong or oblong-lanceolate, thin, dark green and rough above and glaucous beneath, or bright green and smooth or nearly so on both sides, 3' to 4' long. Flowers reddish-brown, with linear sepals and petals, often in-odorous. Fruit irregularly obovoid, ribbed, somewhat glaucous, 18'' to 30'' long, much more common than in No. 1, whence one of the specific names above. Fruit said to be poisonous to sheep. Sometimes cultivated. May to Aug.

3. *C. glaucus*, WILLD. A shrub, 6° to 8° high, found in low, shady woods along the mts. of Ga. and Ala. Branchlets, etc., smooth as in No. 2, but the *leaves ovate or ovate-lanceolate, 4' to 7' long, rigid, conspicuously acuminate, and glaucous-white beneath*. Flowers reddish or yellowish-brown, 1' to 2' wide. May to June.

4. *C. occidentális*, HOOK. AND ARN. WESTERN CALYCANTHUS. An ornamental shrub from Cal., 8° to 12° high, with smooth, ovate or oblong-ovate, slightly cordate leaves 5' to 6' long, green on both sides or sometimes slightly pubescent beneath. Flowers scentless, brick-red, 3' wide.

ORDER 38. SAXIFRAGACEÆ — SAXIFRAGE FAMILY

Herbs, shrubs, or trees, with alternate or opposite, usually exstipulate leaves and mostly perfect flowers. Calyx of 5, rarely 4 to 12, more or less united sepals, free, or more or less adherent to the ovary, usually persistent. Petals generally 4 or 5, rarely wanting, mostly perigynous. Stamens as many or twice as many as the petals, rarely indefinite. Carpels usually 2, sometimes 3 to 4, usually united at base, and separate and divergent above. Fruit usually capsular, baccate or follicular. Seeds many. Embryo straight in the axis of abundant fleshy albumen.

Suborders and Genera

Suborder I. **SAXIFRAGÆÆ**. Herbs. Leaves mostly alternate. Fruit follicular or capsular. Styles or carpels more or less separate and divergent.

Stamens 10. Ovary 2-celled, rarely 8-celled. (a)

Stamens 10. Ovary 1-celled, with 2 parietal placentæ. (b)

Stamens 5. Ovary 1-celled, with 2 to 4 parietal placentæ. (c)

a. Flowers perfect. Leaves simple	SAXIFRAGA	I
a. Flowers polygamous. Leaves compound	ASTILBE	II
b. Petals none	CHRYSOSPLENIUM	III
b. Petals entire	TIARELLA	IV
b. Petals pinnatifid	MITELLA	V
c. Flowers small, in a long panicle	HEUCHERA	VI
c. Flowers large, solitary, terminal	PARNASSIA	VII

Suborder II. **HYDRANGÆÆ**. Shrubs, with opposite, simple, exstipulate leaves and capsular fruit.

Petals valvate. (a)

Petals convolute. (b)

a. Erect shrubs. Outer flowers usually large and neutral	HYDRANGÆA	VIII
a. Climbing shrubs. All the flowers perfect	DECUMARIA	IX
b. Stamens 20 or more. Petals 4	PHILADELPHUS	X
b. Stamens 10. Petals 5. Exotic	DEUTZIA	XI

Suborder III. **RIBESIÆÆ**. Shrubs, with alternate, palmately veined, simple leaves, and fruit a berry.

Only one genus **RIBES** XII

I. SAXIFRAGA, L. SAXIFRAGE. Perennial, rarely annual, herbs, with alternate, radical, or opposite, simple leaves, and white, yellow, or rarely purple or pink, perfect flowers in panicles or corymbs. Calyx tube short or elongated, free or coherent with the base of the ovary; lobes 5, erect or spreading. Petals 5, entire, inserted with the stamens in the tube of the calyx. Stamens 10, rarely 5; anthers 2-celled. Styles 2, short. Capsule 2-celled, 2-beaked, of 2 carpels united below, divergent above, many-seeded.

Of ten or more species within the limits of this flora, several are alpine or confined to the extreme north, while only the two given below are of wide distribution and common.

1. **S. Virginianensis, Mx. EARLY SAXIFRAGE.** A striking, perennial herb, of early spring, common in dry or rocky woodlands and hillsides from Me. to Minn. south to Ga. and Tenn. Leaves radical, rosulate, ovate-spatulate, obtuse, narrowed to a petiole, 1' to 2' long, crenate-dentate, rather fleshy. Flowers white, or tinged with purple, 2'' to 3'' wide, many, in a clustered cyme, at length a loose panicle at the top of a clammy-pubescent, naked, or few-bracted scape 4' to 12' high. Petals oblong-spatulate, much exceeding the erect, triangular-ovate calyx lobes. Ovary nearly free. Carpels becoming widely divergent and purplish. April to June.

2. **S. Pennsylvanica, L. SWAMP SAXIFRAGE.** A perennial herb, similar to No. 1, but very much larger, common in swamps and wet lands from Me. to Minn. south to Va. and Mo. Leaves radical, fleshy, pale green, oblong-lanceolate, obovate, or oval, 4' to 10' long, denticulate or repand, rather acute at apex, tapering at base to a short, broad petiole. Flowers greenish, about 2'' wide, in cymes in a large, oblong panicle on a stout, hairy-viscid, hollow, nearly naked scape 1° to 3° high. Petals linear-lanceolate, longer than the reflexed, ovate calyx lobes. Filaments awl-shaped or thread-like. Carpels divergent. May.

II. ASTÍLBE, DON. Perennial herbs, with large, 2 to 3-ternately compound leaves, and small, polygamous, spicate, or racemed flowers in a compound panicle. Calyx small, bell-shaped, with 4 or 5 erect lobes. Petals small, 4 or 5, linear-spatulate, withering-persistent. Stamens 8 or 10, inserted with the petals at the base of the calyx and exserted on elongated filaments. Ovary 2 to 3-celled, nearly free, many-ovuled; styles 2 to 3. Carpels in fruit separating into 2 to 3 follicles, each few-seeded and dehiscing lengthwise inside.

1. A. decándra, DON. FALSE GOAT'S BEARD. An erect, slightly pubescent herb, 3° to 6° high, closely resembling *Spiræa Aruncus*, but coarser and weed-like, common in rich, mountain woods from southwestern Va. to N.C., Ga., and Tenn. Leaves petioled, 1° to 2° wide. Leaflets ovate, mostly somewhat heart-shaped, acuminate, sharply serrate or incised, 2' to 5' long. Flowers yellowish-white, about 2'' wide, sessile or subsessile, in panicles often 1° long. Petals in the staminate flowers spatulate, in the fertile ones minute or wanting. Stamens 10. Follicles 2'' long, distinct. The 10 stamens and 2 follicles, as also the irregularly cleft leaflets, clearly distinguish this plant from *Spiræa Aruncus*, the true *Goat's Beard*.

III. CHRYSOSPLÉNÍUM, TOURN. Small, low, smooth, somewhat succulent, often aquatic herbs, with thickish, simple, petiolate, toothed, exstipulate leaves, and minute, perfect, apetalous, solitary or clustered flowers. Calyx tube adherent to the ovary; lobes more or less colored within. Stamens 8 to 10, rarely 4 to 5, short, inserted in the edge of a disk. Styles 2. Capsule obcordate or 2-lobed, compressed, 1-celled with 2 parietal placentæ, 2-valved above, many-seeded.

1. C. Americánum, SCHWEIN. GOLDEN SAXIFRAGE. WATER CARPET. A plant with slender, smooth, square, forking stems, 3' to 8' long, spreading over the muddy surface in springs and streams and wet places from Me. to Mich. and Minn. south to Ohio and along the mts. to Ga. Leaves mostly opposite, roundish, or slightly heart-shaped, somewhat crenate, 3'' to 8'' long. Flowers distant, about 1'' wide, axillary, sessile or nearly so, usually solitary. Calyx lobes usually 4, greenish, tinged with yellow or purple. Stamens 8, *with conspicuous, orange-red anthers*. The terminal flower has sometimes 10 stamens. April, May.

IV. TIARÉLLA, L. Slender, erect, perennial herbs, with mostly radical, long-stalked, simple or trifoliolate leaves, small stipules adnate to the petiole, and white flowers on slender pedicels in racemes or panicles. Calyx tube short, bell-shaped, nearly free from the ovary, 5-lobed. Petals 5, entire, with claws inserted in the calyx. Stamens 10, exserted on slender filaments. Styles 2. Capsule 1-celled, 2-valved, 1 valve usually larger. Seeds few.

1. *T. cordifolia*, L. FALSE MITERWORT. FOAM FLOWER. A low, hairy herb, of rich, moist, or rocky woods from Me. to Minn. and Ind. and south along the mts. to Ga. Leaves from a rootstock or, after flowering, from runners, roundish in outline, *cordate at base*, sharply lobed and toothed, 2' to 4' long, somewhat hairy above, downy beneath. Flowers about 3' wide, in a simple raceme on a slender, pubescent, sometimes bracted scape 10' to 20' high. *Calyx lobes white*, shorter than the petals, which are sometimes slightly dentate or serrate. April, May.

V. *MITÉLLA*, Tourn. MITERWORT. BISHOP'S CAP. Slender, erect, perennial herbs, with long-stalked, ovate or roundish, radical leaves, closely allied to those of the preceding genus, but specially and chiefly different in having pinnatifid petals, short filaments, and equally beaked or miter-shaped pods. Flowers small, white or greenish, in spicate racemes, on slender, erect, naked or 1 or 2-leaved scapes. Calyx short, 5-cleft, attached to the base of the ovary. *Petals 5, pinnatifid*. Stamens 5 or 10, included. Styles 2, short. Capsule 2-beaked, 1-celled, equally 2-valved at the top. Seeds smooth, shining.

1. *M. diphýlla*, L. TWO-LEAVED MITERWORT OR BISHOP'S CAP. A hairy perennial, common in rich woods from Me. to Minn. south to N.C. and Ga. Leaves heart-shaped, acute or acuminate, 1' to 3' long, somewhat lobed, dentate; those on the many-flowered scape 2, near the middle, opposite, smaller, and subsessile. Scape 12' to 18' high. Raceme 6' to 8' long. *Calyx lobes white*. Stamens 10. May.

VI. *HEÛCHERA*, L. Perennial herbs, with mainly radical, long-petioled, roundish, heart-shaped leaves, stipules adnate to the petiole, and small, white, greenish, or purplish flowers in panicles or racemes on scapes. Calyx bell-shaped, often oblique, coherent with the base of the ovary, 5-cleft. Petals 5, small, often shorter than the calyx segments, spatulate, entire, inserted with the 5 stamens in the throat of the calyx. Styles 2, slender. Capsule 1-celled, with 2 parietal placenta, 2-beaked, dehiscent between the beaks. Seeds many, rough or hispid.

1. *H. Americana*, L. ALUM ROOT. A plant with an astringent rootstock and scape-like stems, common in rocky woodlands from Conn. to Minn. south to Ga. and La. Stems erect, 1° to 3° high, stout, viscid-pubescent, naked or with only a few bracts. Leaves roundish, heart-shaped, 2' to 4' wide, with 7 to 9 short, rounded, crenate-dentate lobes. Stamens with orange anthers much exserted. May to Aug.

2. *H. villosa*, Mx. A plant with tufted, scape-like stems, 1° to 3° high, densely villous, with rusty hairs, found in mountainous regions and rocky places from Md. to Ga. west to Ind. and Mo. Leaves roundish, 3' to 6' wide, with 7 to 9 distinct, acute or obtuse, dentate lobes, smooth above, but villous on the veins beneath like the stems and petioles. Flowers in loose panicles. Petals white, spatulate-linear, twice as long as the calyx lobes, and equaling the much exserted stamens. June to Sept.

VII. PARNÁSSIA, L. GRASS OF PARNASSUS. Smooth, perennial herbs, with ovate or kidney-shaped, entire, long-petioled, radical leaves, and large, solitary flowers on long, scape-like stems bearing usually a single, sessile leaf. Calyx tube very short, free or adnate to the base of the ovary; lobes 5, spreading, persistent. Petals 5, veined, spreading, marcescent. Fertile stamens 5, alternate with the petals and with clusters of gland-tipped filaments at their bases. Ovary 1-celled, with 3 to 4, usually 4, parietal placentæ. Stigmas 4, sessile, over the placentæ. Capsule 4-valved. Seeds many, winged, without albumen.

1. *P. Caroliniæna*, Mx. An interesting plant found in swamps, low meadows, and wet grounds from Me. to Va. west to Ill. and Iowa. Roots fibrous. Stems 8' to 24' high. Leaves ovate, broadly oval, or roundish, smooth, leathery, 7-veined; the cauline one clasping, much below the middle. Flowers white, 9' to 18' wide. Petals broadly oval, with greenish veins much longer than the ovate-oblong calyx lobes. *Sterile filaments usually 3 in each set, stout, not longer than the fertile stamens.* June to Sept.

2. *P. grandifolia*, DC. A plant found in wet soil from southwestern Va. to Mo. south to Fla. and La., very similar to the preceding and by some identified with it. It differs in having *its sterile stamens, 3 to 5 in a set, slender, and much longer than the fertile ones, and often its leaves narrowed toward the base and much larger than in No. 1.* July to Sept.

3. *P. asarifolia*, VENT. A plant found in mountain brooks and wet places from Va. to Ga., with stems, 10' to 20' high, and round, kidney-shaped leaves, the sessile, cauline one completely encircling the stem. Petals cream-colored, with green veins, elliptical, abruptly contracted into a claw, much longer than the sepals. Sterile filaments 3 in a set, about as long as the fertile stamens. July to Sept.

VIII. HYDRÁNGEA, L. HYDRANGEA. Shrubs or small trees, with opposite, simple, exstipulate, petioled leaves, and many, small, white, bluish, or pinkish flowers in terminal corymbs or panicles. The marginal flowers of the clusters, sometimes all, are usually much enlarged, conspicuous, and sterile, consisting merely of a broad, flat, 4 to 5-cleft, colored calyx without petals, stamens, or pistils. Fertile flowers small. Calyx tube hemispherical, adherent to the ovary, 8 to 10-ribbed, 4 to 5-toothed, persistent. Petals 4 to 5, ovate, valvate in the bud. Stamens 8 to 10. Styles 2 to 4, diverging. Capsule 2-celled, opening by a hole between the styles, many-seeded.

1. *H. arborescens*, L. WILD HYDRANGEA. An erect shrub, 4° to 10° high, found on rocky and shady banks of streams from southern N.Y. and N.J. to Iowa south to Fla. and Mo. Leaves ovate, acute or acuminate, rounded or cordate at the base, dentate-serrate, 3' to 6' long, *green and smooth on both sides or slightly downy or glaucous beneath*, on slender petioles 1' to 3' long. Cymes 2' to 5' wide. Flowers white, becoming pink; often all fertile, especially in the wild state; in cultivation, sometimes all neutral. June, July.

2. *H. quercifolia*, BARTRAM. OAK-LEAVED HYDRANGEA. A stout, leafy shrub, 4° to 8° high, of shady banks in Ga., Fla., and westward, with the young branches and pinnately lobed leaves densely tomentous, and the clustered cymes in close, oblong panicles. Leaves long-petioled, oval or roundish in outline, 4' to 8' long, usually 5-lobed, the lobes serrate, glabrous above, whitish-tomentous beneath. Panicles 4' to 8' long. Flowers pinkish-white; sterile ones numerous, 18'' wide, with roundish sepals turning purple. Often cultivated. May, June.

3. *H. radiata*, WALT. A shrub, 4° to 8° high, on rocky slopes in the upper regions of Ga., the Carolinas, and Tenn., similar to No. 1, but with the leaves silvery white-woolly beneath, and a few sterile flowers always around the margin of the flat-topped cymes. May, June.

NOTE. — The cultivated hydrangeas, not native, include many varieties of *H. paniculata*, SIEB., for outdoor or hardy species, and of *H. Horténsia*, DC., for those of the greenhouse.

IX. *DECUMARIA*, L. Smooth, climbing shrubs, with aerial rootlets, simple, opposite, petioled, exstipulate leaves, and numerous, small, perfect flowers in peduncled, terminal corymbs. Calyx tube top-shaped, coherent with the ovary; limb 5 to 7-toothed. Petals 7 to 10, oblong-spatulate, valvate in the bud. Stamens 20 to 30, epigynous. Styles united. Stigma 7 to 10-rayed. Capsule urn-shaped, 10 to 15-ribbed, opening between the ribs, 7 to 10-celled, many-seeded. A monotypic genus of southeastern U.S.

1. *D. bárbara*, L. *DECUMARIA*. A handsome climber, ascending trees, 15° to 30°, in swamps and damp woods from southeastern Va. to Fla. and La., and cultivated for ornament. Leaves ovate or oval, obtuse or acute, 2' to 4' long, entire or obscurely serrate, very smooth and shining above, sometimes somewhat pubescent beneath. Flowers white, fragrant, 3'' to 4'' wide. Corymbs 2' to 3' wide. Capsule pendulous. May, June.

X. *PHILADELPHUS*, L. MOCK ORANGE. FALSE SYRINGA. Shrubs, with opposite, simple, exstipulate, petioled leaves, and showy white or cream-colored flowers. Calyx tube top-shaped, adherent to the ovary, with 4 to 5 spreading, persistent lobes, valvate in the bud. Petals 4 to 5, roundish or obovate, convolute in the bud. Stamens 20 to 40, shorter than the petals. Ovary 3 to 5-celled. Styles 3 to 5, distinct or united below. Capsule 3 to 5-celled, splitting loculicidally into 3 to 5 valves. Seeds many, ariled, on axile placentæ. Its species are often improperly called *Syringa*, the generic name of the *Lilacs*.

1. *P. coronárius*, L. COMMON M. O. A European shrub, 8° to 10° high, with erect branches, in ornamental cultivation for at least several hundred years, and somewhat escaped in Va. and Ohio and portions of the Eastern and Middle States. Leaves short-petioled, oblong-ovate, acute or acuminate, 2' to 4' long, serrately denticulate, smoothish, with the odor of cucumbers when crushed. Flowers 12'' to 18'' wide, in terminal racemes, cream-colored; in general aspect and fragrance resembling those of the orange, whence its common name. May, June.

2. *P. inodorus*, L. SCENTLESS M. O. A smooth shrub, 6° to 8° high, with slender, spreading branches, found along streams and in moist woods from Va. to Ga., Miss., and Tenn. and escaped from gardens in Pa. Leaves ovate or oval, acute or acuminate, narrowed at the base, 2' to 5' long, strongly 3-nerved, entire or with a few minute teeth. Flowers inodorous, white, 10'' to 15'' wide, solitary or 2 or 3 together and terminal. Calyx lobes acute, not longer than the tube. May, June.

3. *P. grandiflorus*, WILLD. LARGE-FLOWERED M. O. A somewhat pubescent shrub, 6° to 10° high, with long, recurved branches, found along streams from Va. to Fla., similar to No. 2 and somewhat confounded with it, one being possibly a mere variety of the other. The principal points of difference besides the branching and pubescence are the larger flowers, 18'' to 24'' wide, in terminal umbels of 2 or 3, and sometimes axillary to the upper leaves, and the slender calyx lobes twice as long as the tube. April, May.

4. *P. hirsutus*, NUTT. HAIRY M. O. An upright or spreading shrub, 3° to 6° high, common along streams from N.C. and Tenn. to Ga. and Ala. Leaves ovate or ovate-lanceolate, acuminate, dentate-serrate, 1' to 3' long, pubescent above, hairy and often hoary beneath. Flowers cream-white, 12'' to 16'' wide, solitary or 2 or 3 together. May.

XI. DEUTZIA, THUN. Hardy, mostly Asiatic, ornamental shrubs, with simple, opposite, petioled, usually ovate, acuminate, and serrate leaves, and showy, white or pinkish flowers in axillary and terminal racemes or corymbs. Calyx teeth 5. Petals 5. Stamens 10, usually with flat, 3-toothed filaments, the anther on the middle one. Styles 3 to 5. Pods 3 to 5-celled, many-seeded.

1. *D. gracilis*, SIEB. AND ZUCC. A shrub from Japan, 1° to 3° high, with slender, arching branches, smooth, bright green, oblong-lanceolate, acuminate, sharply serrate leaves 1' to 2' long, and pure white flowers in racemes. Petals erect or spreading. Calyx teeth persistent. May, June.

2. *D. scabra*, THUN. A tall shrub from Japan, 6° to 8° high, with dull green, ovate to ovate-lanceolate, crenate-dentate leaves 1' to 3' long, roughly pubescent on both sides, and dull white or pinkish flowers. Petals erect. Calyx teeth deciduous. June, July.

XII. RIBES, L. CURRANT. GOOSEBERRY. Low, prickly or unarmed shrubs, with alternate, often fascicled, palmately veined and lobed, simple leaves, and small, racemed or subsolitary flowers. Stipules wanting or adnate to the base of the petiole. Calyx adherent to the ovary, with 4 to 5-lobed, often colored limb. Petals and stamens 4 to 5, inserted alternately in the throat of the calyx, the former small and scale-like, usually erect, often included, the latter included or exserted. Styles 2, distinct or united. Ovary 1-celled, with 2 parietal placentæ. Fruit a globous or ovoid, pulpy berry crowned with the persistent calyx. Seeds few or many.

- § 1. **CURRENTS.** Stems unarmed. (a)
 a. Flowers greenish or whitish, small. Nos. 1, 2, 3
 a. Flowers yellow, large No. 4
 § 2. **GOOSEBERRIES.** Stems spiny. (b)
 b. Fruit prickly or hairy Nos. 5, 6
 b. Fruit smooth Nos. 7, 8

1. *R. rubrum*, L. **COMMON RED CURRANT.** An unarmed bush, with straggling or curving stems, 2° to 4° high, introduced in garden cultivation from Europe, but native in cold and damp woods from New Eng. to N.J. west to Ind. and Minn. and northward. Leaves obtusely 3 to 5-lobed, subcordate, mucronately serrate, pubescent when young, becoming smooth, 1' to 3' wide, on petioles about as long. Flowers greenish or purplish, about 2'' wide, in loose, drooping racemes from lateral buds different from the leaf buds. Bracts much shorter than the pedicels. Calyx short, rotate. Petals minute. Stamens short. Style short, 2-cleft. Fruit globose, smooth, shining, 2'' to 4'' in diameter, bright red, with yellowish, white and striped varieties.

2. *R. flóridum*, L'HER. (*R. AMERICANUM*, MILL.) **AMERICAN BLACK CURRANT.** An unarmed, spreading bush, 2° to 4° high, with somewhat drooping branches, common in woods from Me. to Va. and westward to Dak. and Kan. Leaves subcordate, sharply 3 to 5-lobed, lobes acute and doubly serrate, with yellowish, resinous dots on both sides, chiefly beneath. Flowers greenish or white, 4'' to 5'' long, in many-flowered, drooping racemes from the same buds as the leaves. Bracts linear, often longer than the pedicels. Calyx tubular-bell-shaped, not resinous-dotted, with large, petal-like lobes. Fruit smooth, round-oval, black, about 3'' in diameter, resembling No. 3 in smell and flavor. April, May.

3. *R. nigrum*, L. **EUROPEAN BLACK CURRANT.** An Old World, unarmed shrub, with upright stem, sometimes cultivated in American gardens, very similar to No. 2. Leaves with minute, yellow, resinous dots, only beneath. Racemes few-flowered, 5 to 10. Bracts minute. Calyx tube broadly urn-shaped and resinous-dotted. Berry round, black, of mawkish flavor, but reputed medicinal in the form of jelly.

4. *R. adreum*, PURSH. **MISSOURI C. BUFFALO C.** An unarmed bush, with slender, erect stems, 4° to 6° high, growing along streams from Minn. to Mo. and Tex. and westward, and widely cultivated for ornament. Leaves convolute in the bud, wedge-shaped, 3 to 5-lobed, entire or with a few coarse teeth, smooth, shining, and firm when mature. Flowers golden-yellow, 5'' to 6'' long, spicy-scented, in short, loose, leafy-bracted racemes. Calyx smooth, salver-shaped, tube 3 times as long as the oval lobes. Petals obovate, red, much shorter than the calyx lobes. Stamens somewhat exserted. Fruit round or oval, brown or black, smooth. April, May.

5. *R. cynósebatl*, L. **PRICKLY GOOSEBERRY.** A compact, thorny, and prickly bush, 2° to 4° high, found in rocky woods from Me. to the mts. of N.C. west to Dak. and Mo. Branches usually smooth, sometimes with a few weak prickles. Thorns usually single, sometimes 2 or 3, slender, 3'' to 5'' long. Leaves 3 to 5-lobed, 1' to 2' wide, with cordate or truncate base, and coarsely toothed, crenate-dentate or incised lobes, on slender, pubescent petioles 6'' to 18'' long. Flowers greenish, 3'' to 4'' long, 1 to 3, on slender pedicels and peduncles. Calyx tube broadly bell-shaped, much longer than the narrow lobes. Petals minute. Ovary glandular-hispid. Fruit roundish-oval, 4'' to 6'' in diameter, brownish-purple, generally prickly, edible. April, June.

6. *R. Uva-crispa*, L. (or *R. GROSSULARIA*, L.). **EUROPEAN G. A** European shrub, common in cultivation and somewhat escaped in eastern N.J. and southeastern N.Y. Stems stout, rigid, fruiting branches without prickles. Thorns stout, with a wide base, usually in 3's, 5'' to 6'' long.

Leaves thick and very glossy ; otherwise much like those of No. 7. Peduncles and flowers nearly the same ; but ovary pubescent or glandular. Berry oval, green, yellowish-green, or red, minutely pubescent or smooth ; often, also, with a few prickles or gland-tipped hairs.

7. *R. oxyacanthoides*, L. COMMON OR NORTHERN SMOOTH G. A low bush, 2° to 4° high, with slender, curving, often crooked, reddish-brown branches, growing in wet woods or grounds from Me. to Dak. south to N.J. and Ind. *Thorns solitary or in 3's, slender, very sharp, 3" to 5" long, sometimes wanting.* Leaves thin, roundish, varying from wedge-shaped to heart-shaped, deeply 3 to 5-lobed, lobes coarsely toothed and cut. Flowers greenish-white or dull purplish, 1 or 2, on short peduncles. Calyx tube bell-shaped, with oblong, petal-like lobes as long as the stamens and twice as long as the ovate or spatulate petals. Ovary smooth. Fruit round, perfectly smooth and glaucous, globose, 4" to 6" in diameter, yellowish-green or reddish-purple when ripe. The parent of the American gooseberries of the gardens.

8. *R. rotundifolium*, Mx. EASTERN SMOOTH G. A low shrub, found in western Mass. and southward along the mts. to N.C. Somewhat like No. 7, but with usually *straight, light-colored branches, very short, usually solitary thorns, and more rounded and wedge-shaped leaves, and these last with ciliate margins and veins.* Flowers greenish or dull purplish, 1 to 3, on short peduncles. Calyx lobes shorter than the exerted stamens. Berry globose, 3" to 4" in diameter, smooth, purplish, agreeable in flavor. May, June.

ORDER 39. CRASSULACEÆ — ORPINE OR STONECROP FAMILY

Mostly succulent herbs or shrubs, with alternate or opposite, exstipulate, usually sessile leaves, and *regular, perfectly symmetrical flowers*, generally in cymes. Sepals, petals, stamens, and pistils of the same number, 3 to 20, or the stamens twice the number. Sepals more or less united below, persistent. Petals distinct or slightly cohering at base, generally persistent, rarely lacking. Stamens alternate with the petals when of the same number ; filaments distinct ; anthers 2-celled, opening lengthwise. Pistils usually distinct, becoming many-seeded follicles opening along the inner suture.

Key to Genera

Succulent plants with pistils and follicles distinct. (a)

a. Sepals, petals, etc., in 4's or 5's **SEDUM** I

a. Sepals, petals, etc., 6 to 20 **SEMPERVIVUM** II

Plants not succulent. Pistils united in a 5-parted capsule . . . **PENTHORUM** III

I. **SEDUM**, L. **STONECROP**. Mostly smooth, fleshy, perennial herbs, with flowers in terminal or 1-sided cymes. Sepals and petals 4 or 5, the latter distinct and spreading. Stamens

8 or 10. Follicles 4 or 5, distinct, many-seeded, with a small scale at the base of each.

Flowers sessile along one side of the flowering branches. (a)

a. Flowers on the branches with parts in 4's; central one in 5's	. . .	Nos. 1, 2
a. Flowers all with parts in 5's	. . .	No. 3
Flowers in more or less peduncled, naked, terminal cymes	. . .	Nos. 4, 5

1. *S. ternatum*, Mx. THREE-LEAVED S. A smooth perennial, with tufted, creeping stems, 3' to 8' long, found on rocks in damp woods from N.Y. and N.J. to Ind. south to Ga. and Tenn. Flowering branches, erect or ascending, 3' to 6' high, with usually 3 umbellate, diverging, often leafy-bracted spikes of sessile, 4-parted, white flowers, each with 8 stamens, and a central, 5-parted one, with 10 stamens. Leaves flat, smooth, obovate, entire, those below and on the sterile branches whorled in 3's; upper ones scattered, oblong, sessile. April to Aug.

2. *S. pulchellum*, Mx. WIDOW'S CROSS. A smooth, trailing perennial, 4' to 12' long, with ascending branches 3' to 6' high, found on rocks from Va. to Kan. south to Ga. and Tex., and in cultivation. Leaves alternate, sessile, crowded, linear, terete. Flowers rose-purple, crowded, usually in 4 or 5 spreading spikes; otherwise as in No. 1. May to July.

3. *S. acre*, L. Mossy S. WALL PEPPER. A creeping, moss-like, European perennial, cultivated for borders and rock work and escaped from cultivation in New Eng., eastern N.Y., and Pa. Stems spreading on the ground. Leaves yellowish-green, very small, 2'' to 3'' long, thick, fleshy, somewhat ovate, obtuse, sessile, alternate, crowded. Flowers yellow, 6'' wide, in 2 to 5 few-flowered, umbellate spikes. Sepals, petals, and pistils 5; stamens 10. Juice acrid. June to Aug.

4. *S. Telèphium*, L. ORPINE. LIVE FOREVER. A smooth, somewhat glaucous, European perennial, 1° to 2° high, very common in country gardens and escaped and somewhat naturalized from Me. to Md. and Mich. Stems simple, erect, stout, tufted, very leafy. Leaves flat, scattered, rarely opposite, ovate, oval, or obovate, coarsely toothed, 1' to 2' long, fleshy, mostly sessile. Flowers purple, 3'' to 4'' wide, in dense, terminal, compound cymes, seldom blooming. Sepals, petals, and follicles, each 5; stamens 10. Petals twice as long as the sepals. Pods short-pointed. June to Aug.

5. *S. telephioides*, Mx. AMERICAN ORPINE. A smooth perennial, found on dry rocks from western N.Y. to southern Ind. and northern Ga., similar to No. 4, as indicated by its specific name. It differs chiefly in having its more slender, ascending stems, 6' to 12' high, very glaucous and purplish, its leaves sparingly toothed and narrowed at the base, the lower ones petioled, the flowers pale pink, and the pods with slender points. June to Aug.

II. *SEMPERVIVUM*, L. HOUSELEEK. Mostly perennial herbs, with thick, fleshy leaves closely imbricated on the short, rosette-like, sterile offsets and scattered on the erect or ascending, flowering stems. Sepals, petals, and pistils 6 to 20; stamens twice as many. Flowers in paniced cymes.

1. *S. tectdum*, L. COMMON H. HEN AND CHICKENS. A hardy, European perennial, common in old gardens, of such vitality that it grows on walls, bare stones, and roofs of houses (tectorum). Offsets 3' to 4' wide; their leaves pale green with a reddish tip, obovate or oval, cuspidate, 1' to 2' long, smooth, with fringed margins; those of the erect stems

oblong, clammy-pubescent. Flowers 9" to 12" wide, with the parts usually in 12's. Petals pink or purplish. *Stamens often transformed to pistils*. Flowering stems rarely develop. Aug.

III. PÉNTHORUM, L. Erect, perennial herbs, with alternate, serrate, *thin leaves, not at all fleshy*, and yellowish-green flowers on one side of the revolute branches of the simple cyme. Sepals 5. Petals 5 or 0. Stamens 10. Pistils 5, united into a 5-celled, 5-lobed, 5-horned, many-seeded capsule.

1. *P. sedoides*, L. DITCH STONECROP. VIRGINIA S. A homely, weed-like plant, common in ditches and muddy places from Me. to Minn., Fla., and Tex. Stem smooth, erect, 6' to 16' high, branched and angular above. Leaves lanceolate, acute at each end, finely serrate, nearly sessile, 2' to 4' long. Branches of cyme 2 to 3. Flowers 2" wide, on short pedicels. Petals usually wanting. July to Sept.

ORDER 40. DROSERACEÆ — SUNDEW FAMILY

Mostly low bog herbs, with alternate or radical and rosulate, glandular-hairy leaves, usually rolled from the tip in the bud like a fern, and regular, hypogynous, 5-merous flowers. Sepals usually 5, united below or distinct and imbricated, persistent. Petals usually 5, convolute, withering-persistent. Stamens usually 5 to 15, withering-persistent; anthers attached by the middle and extrorse. Capsule 1-celled, with 3 to 5 parietal placentæ and twice as many separate or united styles or stigmas. Seeds many. Embryominate at the base, of fleshy albumen.

Key to Genera

Stamens 5. Leaves bristly glandular	DROSERÆ I
Stamens 10 to 15. Leaves closing convulsively like a trap	DIONÆÆ II

I. DRÓSERÆ, L. SUNDEW. In our species, small, aquatic, perennial herbs, with rosulate, radical leaves clothed with reddish, glandular bristles secreting a dew-like, viscid liquid that entraps insects. Flowers on a scape in a 1-sided raceme, each opening but once in sunshine. Stamens 5. Styles 3 to 5, each 2-parted and so seeming like 6 to 10. Capsule with 3, rarely 5, valves.

1. *D. rotundifolia*, L. ROUND-LEAVED S. A very small plant, growing in bogs and wet, sandy, or muddy shores from Me. to Minn. south to Fla. and Ala. Leaves orbicular, 3" to 6" long, on slender, hairy petioles 2 or 3 times as long. Scape 5' to 8' high. Flowers white, about 2" wide, in a raceme, uncoiling as the flowers open. June to Aug.

2. *D. capillaris*, POIR. A more delicate plant than No. 1, found in boggy ponds from S.C. to Fla. and Tex. Leaves obovate or spatulate, narrowed into a smooth petiole, 3 times as long as the blade, which is 2"

to 3" wide. Scape smooth, slender, erect, 3' to 6' high, simple or forked, 9 to 20-flowered. Petals pale rose-color or light purple. April, May.

3. *D. filiformis*, RAF. **THREAD-LEAVED S.** A species growing in wet, sandy places along the coast from Mass. to Fla. Leaves filiform, 6' to 16' long, about 1" wide, without distinction of blade or petiole, glandular-pubescent throughout. Scape erect, smooth, longer than the leaves, bearing a 1-sided raceme of 10 to 30 purple flowers 6" to 12" wide. July to Sept.

II. DIONÆA, ELLIS. Smooth perennial herbs, with spreading, rosulate, radical leaves, and bracted, white flowers in a terminal, umbel-like cyme on a scape. Sepals 5, spreading. Petals 5, obovate. Stamens 10 to 15. Styles united into 1. Stigmas 5, fimbriate. Capsule 1-celled, opening irregularly. Seeds many, attached to placenta at the base of the pod. Leaves, on broadly winged, spatulate petioles, orbicular, notched at base and apex, and fringed on the margins with strong bristles.

1. *D. muscipula*, ELLIS. **VENUS'S FLYTRAP.** A famous plant, native only in the sandy bogs on the southeastern coast of N.C. and the adjacent portion of S.C., often cultivated for its scientific interest. Scape 6' to 12' high, with 8 to 10 flowers, each about 1' wide. The two halves of the leaf blade close convulsively, like a steel trap, upon an alighting fly or other insect, which is thereupon pinned down and held by the marginal bristles. April, May.

ORDER 41. HAMAMELIDACEÆ — WITCH-HAZEL FAMILY

Shrubs or trees, with alternate, simple, petioled leaves, deciduous stipules, and perfect, often polygamous or diœcious flowers in heads or spikes. Perianth often incomplete, sometimes wholly wanting. Calyx, when present, adherent to the base of the ovary. Petals linear or none. Stamens twice as many as the petals, those opposite them sterile and scale-like, or numerous. Ovary of 2 carpels, 2-celled, 2-styled; ovules 2 or many. Fruit a woody capsule, 2-beaked, 2-celled, 1 to 2-seeded. Seeds with little albumen, inclosing a large, straight embryo.

Key to Genera

- a. Petals 4. Calyx 4-lobed. Perfect stamens 4 **HAMAMELIS** I
 a. Petals and calyx wanting. Stamens many. Flowers monœcious **LIQUIDAMBAR** II

I. HAMAMELIS, L. Hardy shrubs or small trees, with straight-veined leaves and yellow, perfect, or polygamous flowers in axillary clusters. Calyx 4-parted, with 2 to 3 bracts at the base. Petals 4, linear, alternate, with 4 short, perfect sta-

mens, and opposite 4 scale-like, sterile ones. Capsule nut-like, 2-celled, 2-beaked, 2-seeded, each cell bursting elastically at maturity and discharging its single, large, bony seed.

I. H. Virginiana, L. WITCH-HAZEL. A shrub, 6° to 12° high, with several diverging stems, or sometimes a small tree, attaining 20° to 25°, common in low woods and along ravines from Me. to Minn., Fla., and Tex. Leaves short-petioled, thick, nearly smooth, oval or obovate, 2' to 5' long, *with wavy-toothed margin*, blunt or acute apex, and *more or less obliquely cordate base*. Flowers sessile, 8 to 4 together on axillary peduncles, with *very narrow, linear, twisted. yellow petals 8" to 9" long, appearing in late autumn, when the leaves have mostly fallen and the fruit is discharging its seeds*, giving occasion for the generic name, Greek for "*fruit at the same time with*" the flower. The fruit is from the flower of the previous autumn. The small, forked branches have been superstitiously used as "*divining rods*" for finding water and precious metals. The witch-hazel of pharmacy is an extract from its bark and leaves. The only other species are two from Japan, which bloom in the spring and are in ornamental cultivation. Oct., Nov.

II. LIQUIDÁMBAR, L. Trees, with resinous sap, lobed leaves, and usually monœcious flowers in heads or catkins. Sterile flowers naked, with very many short stamens mingled with small scales in racemed, conical, or globular heads, each catkin, or head, with a deciduous, 4-leaved involucre. Fertile flowers sessile, each a 2-celled, 2-beaked ovary, without corolla, and with calyx represented by a minute scale, cohering more or less together, and forming in fruit a spherical, spinose head, the spines being the divergent beaks. Ovules many, but only 1 or 2 maturing.

I. L. Styraciflua, L. SWEET GUM. BILSTED. ALLIGATOR TREE. A large tree, 60° to 140° high, with rough bark and *branchlets usually winged with corky ridges*, found in low, moist ground, or in the south in elevated and dry lands, from Conn. and southern N.Y. to southern Ill. and Mo. south to Fla. and Tex. Leaves fragrant when bruised, smooth and shining above, roundish in outline, 3' to 5' long by 3' to 7' wide, with 5 to 7, *usually 5*, deep, lance-ovate, acuminate, finely serrate lobes, and a truncate or *often a cordate base, making the whole ideally star-shaped*, on a slender petiole as long as the leaf. Flowers greenish; staminate in terminal, racemed heads; pistillate in a solitary head on an axillary peduncle. Fruit a many-capsuled, spherical head 12" to 18" in diameter, on a long, drooping peduncle, persistent through the winter. With 1 or 2 good seeds, each capsule is mainly filled with abortive ones resembling sawdust. *The corky ridges on the branchlets*, a very distinctive mark, suggest one of the common names. April, May.

ORDER 42. ONAGRACEÆ—EVENING-PRIMROSE FAMILY

Mostly herbs, annual or perennial, with alternate or opposite, exstipulate leaves, and perfect, mostly regular,

symmetrical, usually 4-merous, sometimes 2 to 3- or 5 to 6-merous flowers. Calyx tube adherent to the ovary, often produced beyond it, its lobes valvate in the bud or obsolete. Petals as many as the lobes of the calyx, convolute in the bud, rarely wanting. Stamens as many or twice as many as the petals and inserted with them in the throat of the calyx tube. Styles united into 1, with a capitate or 2 to 4-lobed stigma. Ovary 2 to 4-celled. Fruit a capsule, nut, or berry. Seeds small, anatropous, with little or no albumen.

Key to Genera

Stamens 8.	(a)	
a.	Fruit a capsule. Seeds comous	EPILOBIUM I
a.	Fruit a capsule. Seeds naked	GNOTHERA II
a.	Fruit a berry. Exotic	FUCHSIA III
Stamens 4	. . . . .	LUDWIGIA IV
Stamens 2	. . . . .	CIRCEA V

I. EPILÒBIUM, L. WILLOW-HERB. Perennial herbs, or sometimes shrubby plants, with alternate or opposite, *willow-like* leaves and axillary or terminal, spiked, racemed, or solitary flowers. Calyx tube linear, not prolonged, or but slightly, beyond the ovary; lobes 4, deciduous. Petals 4. Stamens 8. Stigmas sometimes 4-lobed. Capsule linear, 4-sided, 4-celled, 4-valved, opening loculicidally. Seeds many, each tipped with a tuft of silky hairs.

1. *E. angustifolium*, L. GREAT WILLOW-HERB. FIREWEED. A smooth perennial, with simple, erect stem, often branching above, 4° to 7° high, very common, in clearings and *places burned over*, from Me. to Dak. south to N.C. and Kan. Leaves scattered, lanceolate, acute, entire or denticulate, with a marginal vein, 2' to 5' long, subsessile. Flowers pink-purple, sometimes white, 8" to 15" wide, somewhat irregular, in a long, terminal, spike-like raceme. Petals obovate, entire. Stamens and styles declined. Stigma with 4 linear lobes. Corolla whitish. June to Sept.

2. *E. hirsutum*, L. GREAT HAIRY W. A soft-hairy, clammy, European perennial, with a stout, branching stem, 3° to 5° high, somewhat naturalized in New Eng. and N.Y. and sometimes cultivated. Leaves oblong-lanceolate, serrulate, sessile, often clasping, usually opposite, 1' to 3' long, pubescent on both sides. Flowers rose-purple or pale pink, about 1' wide, in a terminal, leafy, corymbose cluster. Petals notched. Stigma 4-lobed. Coma whitish. The whole plant exhales a peculiar, acidulous odor, giving rise in England to such names as *Codlins-and-Cream*, *Apple-Pie*, etc. June to Sept.

3. E. coloratum, MUHL. PURPLE-LEAVED W. An erect, very branching perennial, 1° to 3° high, common in wet and muddy places from Me. to Wis. and Neb. south to S.C. and Mo. Stem somewhat 4-angled, hoary and glandular-pubescent above, smoothish below. Leaves often purplish, as also the stem, opposite and petioled below, alternate and sessile above, lanceolate, 2' to 5' long, sharply denticulate, acute or acuminate.

nate, narrowed at the base. Flowers many, axillary, pink, 2" to 3" wide. Corolla reddish. July to Sept.

II. GENOTHERA. EVENING PRIMROSE. SUNDROPS. Herbs, sometimes shrubby at the base, with alternate, simple leaves and yellow, white, or rose-colored flowers. Calyx tube prolonged beyond the ovary, deciduous; lobes 4, reflexed. Petals 4. Stamens 8; anthers mostly narrow and versatile. Stigma usually 4-lobed. Capsule 4-celled, 4-valved, opening loculicidally. *Seeds many, without a coma.*

Flowers nocturnal	Nos. 1, 2
Flowers diurnal	Nos. 3, 4, 5

1. *G. biennis*, L. COMMON E. P. A more or less pubescent and hairy annual or biennial, with an erect, usually stout, generally simple stem, 1° to 6° high, common in dry, sandy, or stony fields and waste places from the Atlantic to the Rockies. Leaves lanceolate, acute or acuminate, repand-denticulate, 3' to 6' long; upper ones sessile, the lowest petioled. *Flowers yellow, 1' to 2' wide*, opening in the evening, sessile, in terminal, leafy-bracted spikes. Later in the season, they sometimes remain open in the sunshine the following day. *Petals* obcordate or obtuse, *shorter than the calyx tube*, which is 2 or 3 times as long as the ovary. Capsules downy, oblong, narrowed above, 9" to 12" long, nearly terete. Var. *grandiflora*, LINDL., with the same range, but more common west and south, has *flowers 2' to 4' wide*, the *petals as long as the calyx tube*, and larger and thicker leaves. June to Aug.

2. *G. sinuata*, L. A low, spreading annual, in dry, sandy soils from southern N.J. and Pa. to Kan. south to Fla. and Tex. Stems simple or branched, ascending or decumbent, 4' to 20' high, smooth or somewhat hairy. Leaves oblong-lanceolate or oblanceolate, *sinuate-toothed or pinnatifid*, 1' to 2' long. Flowers opening in the evening, pale yellow, turning pink in withering, 6" to 12" wide, solitary and axillary. Capsule linear, 12" to 18" long. Var. *minima*, NUTT., is a dwarf form in pine barrens from N.J. to Ga., with nearly entire leaves and a simple, 1-flowered stem. May, June.

3. *G. fruticosa*, L. COMMON SUNDROPS. A common and *variable*, biennial or perennial herb, with a hard, stiff stem, but not shrubby as implied in its specific name, of dry and sterile soils from Me. to Minn. south to Ga. and La. Stem erect, 1° to 3° high, often stout, hirsute, pubescent, or rarely smooth. Leaves variable in form, size, and pubescence, oblong-lanceolate to linear-lanceolate, repand-denticulate, 1' to 3' long, mostly sessile. *Flowers yellow, 1' to 2' wide, diurnal*, in terminal, leafy-bracted, corymbed spikes. Petals broad, obcordate. *Calyx tube longer than the ovary*. Capsule sessile, or short-pedicelled, oblong-club-shaped, 3" to 4" long, strongly 4-winged, with prominent, intermediate ribs. June to Aug.

4. *G. pumila*, L. SMALL S. A puberulent biennial, with slender, erect or ascending stem, 6' to 20' high, in dry soils from Me. to Dak. south to Ga. and Kan. Leaves entire, obtuse, mostly smooth; radical ones spatulate, those of the stem narrowly oblanceolate, 1' to 2' long. *Flowers 4" to 12" wide, yellow, diurnal*, in loose, terminal, leafy-bracted spikes. *Calyx tube shorter than the ovary*. Capsule oblong-club-shaped, 3" to 6" long, slightly winged. June to Aug.

5. *G. speciosa*, NUTT. SHOWY S. A handsome perennial, of prairies from Mo. and Kan. to La. and Tex., and widely naturalized in S.C., Ga., and Fla. Stems erect, ascending, or decumbent, somewhat branching,

finely pubescent, 6' to 20' high. Leaves lanceolate to linear, repand-denticulate, sinuate, or pinnatifid. *Flowers white, turning pink, diurnal*, 2' to 4' wide, few, loosely spiked. Petals broadly obovate, notched. Capsules club-shaped, 4-winged, 4-ribbed, 5'' to 10'' long. May to July.

III. FUCHSIA, L. Shrubby exotics, mostly from tropical America, with leaves, generally opposite, and showy flowers, usually drooping, on axillary, 1-flowered peduncles, sometimes disposed in terminal racemes or panicles. Calyx highly colored; its tube prolonged beyond the ovary, tubular to bell-shaped; limb 4-lobed, spreading. Petals 4, sometimes wanting. Stamens 8, often exserted. Style usually long-exserted. Stigma capitate or club-shaped. Fruit a 4-celled, oblong berry.

1. F. Magellánica, LAM. (*F. MACROSTÉMA, RUIZ AND PAV.*) COMMON F. OR LADIES' EARDROP. A smooth, greenhouse shrub, 1° to 6° high, from Chile, with lance-ovate, acute, dentate, short-petioled leaves, opposite or in 3's, and axillary, nodding flowers. Calyx normally scarlet; its tube cylindrical, little longer than the ovary; its acute, spreading lobes longer than the convolute, normally violet-purple petals. Stamens long-exserted, crimson. Many varieties are cultivated with colors entirely different.

2. F. fulgens, DC. A smooth, greenhouse shrub from Mexico, with a slightly succulent stem, and soft, large, coarse, cordate-ovate, denticulate, opposite leaves 5' to 7' long, and scarlet flowers in terminal, drooping clusters or racemes. Calyx tube trumpet-shaped, 2' to 3' long, 3 times as long as the lance-ovate, greenish-tipped lobes, which scarcely exceed the pointed, somewhat spreading petals. Stamens and style short-exserted.

IV. LUDWIGIA, L. BASTARD OR FALSE LOOSESTRIFE. Small, aquatic or semi-aquatic herbs, mostly perennial, with alternate or opposite, usually entire leaves, and small, yellow or greenish, mostly 4-merous flowers. Calyx tube not prolonged beyond the ovary; lobes 4, mostly persistent. Petals 4, often small or none. Stamens 4, alternate with the petals. Style short. Capsule short, many-seeded, 4-celled, 4-valved.

1. L. alternifolia, L. SEEDBOX. A smooth or smoothish, erect, branching perennial, 2° to 3° high, found in swamps or wet places from Mass. to Mich. and eastern Kan. south to Fla. and Tex. Leaves alternate, lanceolate, with marginal veins, tapering at each end, entire, 2' to 3' long. Flowers solitary, 6'' to 8'' wide, on short, 2-bracted peduncles in the upper axils, with caducous, yellow petals scarcely exceeding the ovate, acuminate calyx lobes. Capsules cubic, with 4-winged angles and a convex bottom and top, the latter crowned with the purplish sepals. June to Sept.

2. L. palustris, ELL. WATER PURSLANE. A smooth, somewhat succulent perennial, common in ditches, shallow waters, and muddy places from Me. to Dak. south to Fla. and La. Stem prostrate, creeping, or floating, round, reddish, branching, rooting at the nodes, 8' to 18 long. Leaves opposite, entire, ovate or ovate-spatulate, acute or obtuse, 6'' to 12'' long, tapering to a petiole. Flowers solitary, axillary, sessile, about

1" wide. Calyx lobes triangular, acute. Petals none or very small and reddish. Capsules oblong, 2" long, 4-sided. June to Sept.

V. CIRCÆA, L. Low, delicate, perennial herbs, with petioled, opposite leaves, and small, whitish flowers in terminal and lateral racemes. Calyx somewhat prolonged above the ovary; lobes 2, reflexed, deciduous. Petals 2, obcordate. Stamens 2, alternate with the petals; filaments and united styles filiform. Capsule obovoid, bristly or pubescent, 1 to 2-celled, 1 to 2-seeded. Both the two following species are found also in Europe and Asia.

1. C. Lutetiāna, L. ENCHANTER'S NIGHTSHADE. An inconspicuous little herb, very common in damp, shady places from Me. to Neb. south to Ga. and Mo. Stem erect, 1° to 2° high, sparingly branched, tumid at the nodes, pubescent above. *Leaves dark green, opaque, ovate, acuminate, with usually rounded base, remotely denticulate, 2' to 4' long, on slender petioles half as long.* Flowers small, pinkish white. *No bracts. Fruit with bristly, hooked hairs.* June, July.

2. C. alpina, L. SMALLER E. N. A smaller plant than the preceding, with nearly the same range but in the cooler and mountain districts. Stem weak, ascending, 5' to 10' high. *Leaves thin, pale green, shining, ovate, acute or acuminate, with more or less cordate base, coarsely dentate, 1' to 2' long, on slender petioles nearly or fully as long. Bracts present, minute. Hairs on capsule weak, scarcely bristly.* July, Aug.

ORDER 43. PASSIFLORACEÆ — PASSION-FLOWER FAMILY

Herbs or shrubs, usually climbing by tendrils, with alternate leaves and regular, perfect flowers. Sepals 4 to 5, cohering below into a short or elongated tube, the throat crowned with 2 or 3 circles of thread-like processes. Petals 5, inserted in the throat of the calyx outside the crown. Stamens 5, monadelphous or distinct. Ovary superior, on a stipe, 1-celled, with 3 to 4 parietal placentæ and as many styles. Fruit a berry or capsule. Seeds usually many.

I. PASSIFLORA, L. PASSION FLOWER. Perennial herbs or shrubs, climbing by simple axillary tendrils, with usually palmately lobed leaves, foliaceous stipules, and showy flowers on axillary, jointed peduncles. Sepals 5, colored, united at the base into a short tube or cup, with a crown of thread-like organs inserted in the throat with and inside the petals. Petals 5, sometimes wanting. Stamens 5, their monadelphous filaments

sheathing the long stipe of the ovary and separating above. Anthers large, versatile. Styles 3; stigmas capitate. Fruit a pulpy berry, edible in some species.

1. *P. cærdlea*, L. COMMON OR BLUE P. F. A smooth, glaucous, greenhouse shrub from Brazil and Peru, with leaves divided nearly to the base into 5 lanceolate or elliptic, acute, entire lobes, the 2 lower ones sometimes again divided. *Petioles with 4 glands at the apex.* Stipules falcate. Flowers 3' to 4' wide, lasting only a day, faintly scented. Petals and sepals nearly alike in shape and size, greenish-white, the sepals mucronate. Styles purplish. Rays of the crown in 2 sets, purple at the bottom, white in the middle, and blue at the ends. Bracts 3, ovate, entire. Fruit ovoid, yellow.

2. *P. incarnata*, L. AMERICAN P. F. MAYPOP. A pubescent, trailing, or low-climbing perennial, of dry soils from Va. to Mo. south to Fla. and Ind. Terr. Stem 10° to 30° long. Leaves 3' to 5' long and wide, somewhat cordate, deeply 3 to 5-lobed, the lobes oblong, oval or ovate, rather acute, serrate. *Petioles 6'' to 2' long, with 2 glands near the summit.* Flowers 18'' to 2' wide, fragrant, with 3 obovate bracts, on axillary peduncles longer than the petioles. Sepals pale green. Petals white. Rays of the crown in 3 sets, the 2 outer rows long and purple, with a white band, the inner short and pink. Fruit nearly the size and shape of a hen's egg, with 3 sutures, pale yellow, eatable. May to July.

3. *P. lutea*, L. YELLOW P. F. A smooth, slender trailer or climber, 5° to 10° long, in damp woods and thickets from Pa. to Mo. south to Fla. and La. Leaves wider than long, somewhat cordate, with 3 wide, shallow, obtuse, rounded, entire lobes on *glandless petioles.* Flowers greenish-yellow, 9'' to 12'' wide, usually in pairs, on slender peduncles in the upper axils. Crown in 3 sets, the inner one a membranous disk with fringed margin, the 2 outer shorter than the sepals, which are much shorter than the narrow petals. Fruit globular, 6'' in diameter, purple, smooth. May to July.

ORDER 44. CUCURBITACEÆ—GOURD FAMILY

Climbing or trailing herbs, with succulent stems, lateral tendrils, petiolate, palmately lobed or veined or pedate leaves, and solitary, paniced, or fascicled, monœcious or dicecious, often gamopetalous flowers. Calyx 5-toothed, adherent to the ovary. Petals 5, inserted on the calyx, distinct or usually united into a gamopetalous corolla, its lobes alternate with the calyx teeth. Stamens 5, distinct or in 3 sets, 2 with 2-celled anthers and 1 with a 1-celled anther. Anthers long and usually twisted or wavy. Ovary inferior, 1 to 3-celled, with 3 parietal placentæ. Fruit a pepo or membranaceous.

Key to Genera

Climbing vines, with small, white, or greenish flowers. (a)

- | | | |
|--|--------------|-----|
| a. Corolla 6-cleft. Fruit several-seeded | ECHINOCYSTIS | I |
| a. Corolla 5-lobed. Fruit 1-seeded | SICYOS | II |
| a. Corolla 5-petaled. Fruit many-seeded | LAGENARIA | III |

Trailing vines, with large, yellow flowers. (b)

b. Corolla campanulate, 5-lobed	CUCURBITA	IV
b. Corolla subcampanulate, deeply 5-lobed	CITRULLUS	V
b. Corolla with petals nearly distinct, acute	CUCUMIS	VI

I. ECHINOCYSTIS, TORR AND GRAY. Smooth, climbing annuals, with 3-forked tendrils, lobed leaves, and small, monœcious, greenish-white flowers. Calyx 6-parted. Petals 6, united at the base into a rotate corolla. Stamens, in the staminate flowers, 3, with the anthers more or less coherent; in the pistillate ones, abortive, merely 3 minute filaments. Style 1. Stigma large. Ovary 2-celled; 2 erect ovules in each cell. Fruit fleshy, finally dry and membranous, with a fibrous, netted interior, echinate, opening at the apex, 2-celled, 4-seeded.

1. E. lobata, TORR AND GRAY. WILD BALSAM APPLE. A running and climbing vine, along rivers from Me. to Minn. south to Pa., Ky., eastern Kan., and Tex., and often cultivated for arbors. Stem angular, grooved, 10° to 25° long. Tendrils nearly opposite the petioles. Leaves thin, cordate at base, deeply and palmately 5-lobed, the lobes acuminate and denticulate. Flowers small, the staminate ones very numerous, in long, axillary racemes or panicles; the fertile solitary, or rarely 2 or 3 together, in the same axils. Fruit ovoid, green, 1' to 2' long, clothed with slender prickles. Seeds large, flattish. July to Sept.

II. SICYOS, L. Smoothish, climbing annuals, with 3-forked tendrils, thin, lobed leaves, and small, whitish, monœcious flowers; the fertile and staminate usually from the same axils; the former in a long-stalked, capitate cluster, the latter in a corymbose raceme. Staminate flowers, with a 5-toothed calyx, a rotate, deeply parted corolla, and 3 monadelphous stamens. Pistillate flowers with bell-shaped, 5-toothed calyx, and a bell-shaped, 5-parted corolla. Ovary 1-celled, 1-ovuled. Style 1, slender. Stigmas 3. Fruit ovate, membranous, indehiscent, covered with prickly bristles and inclosing 1 large seed.

1. S. angulatus, L. ONE-SEEDED CUCUMBER. STAR CUCUMBER. A weak, clammy, hairy, climbing, or trailing vine, with branching stem, 10° to 25° long, and long, spiral, branching tendrils, found along river banks and in damp places from Me. to Minn. and Kan. south to Fla. and Tex. Leaves roundish, cordate, 3' to 4' wide, 5-angled or 5-lobed, the lobes acute or acuminate and denticulate. Staminate flowers larger than the pistillate ones. Fruit 6'' long, yellowish, sessile, 3 to 10 in a close cluster. July to Sept.

III. LAGENARIA, SER. A softly pubescent, climbing annual, with 2-forked tendrils, roundish, cordate, denticulate leaves, and monœcious, axillary, solitary, peduncled, musk-scented flowers. Petioles with 2 glands at the apex. Calyx bell-shaped, 5-toothed. Petals 5, obovate or obcordate, white, with

greenish veins. Anthers long, contorted, somewhat coherent with each other. Stigmas 3, 2-lobed, subsessile. Staminate flowers on very long peduncles exceeding the leaves; pistillate, mostly on short ones. Fruit with a woody rind, soft flesh, and obcordate, margined, ariled seeds. A monotypic genus, taking its name from the Latin *lagēna*, a flagon or bottle.

1. *L. vulgaris*, SER. GOURD. BOTTLE G. CALABASH. A somewhat clammy, musk-scented, free climber, from tropical Asia and Africa, supposed to be the gourd of history, now extensively cultivated in the Southern States, and in warm countries generally. Fruit pale yellow, of greatly varied shape, as club-shaped, bottle-shaped, etc. The hard rind is used for dippers, bottles, etc. July, Aug.

IV. *CUCURBITA*, L. Rough, prostrate vines, rooting at the joints, with 2 to 5-forked tendrils, mostly lobed leaves, and large, yellow, monœcious, axillary, and mostly solitary flowers. Calyx 5-toothed. Corolla bell-shaped with 5 lobes, coherent at its base with the bell-shaped calyx tube. Stamens 3, with filaments cohering in a tube except at the bottom, and linear anthers more or less united into a small head. Ovary oblong, with 3 to 5 parietal placentæ, a short, thick style, and 3 to 5 2-lobed stigmas. Fruit generally large, smooth, fleshy or ligneous, with a thick, indehiscent rind. Seeds many, smooth, flattened, thickened at the margin.

1. *C. Pèpo*, L. PUMPKIN. SQUASH. GOURD. A running annual, with rough, prickly stem and petioles, very large, *dull green*, cordate, 3 to 5-lobed or -angled, denticulate, rough-bristly leaves. Staminate flowers on long peduncles; pistillate on short ones, which become *very hard and deeply grooved without enlargement next the ripe fruit*. Fruit very large, roundish or oblong, yellow, the interior pulp traversed by coarse threads. Unknown wild, but supposed to be a native of tropical America, having been found cultivated as now in fields of maize by the Indians when America was discovered. Besides this original type, the common field Pumpkin, used for pies and feeding stock, various new forms have been developed by modern cultivation, known generally as *Squashes*, *Scallop*, *Summer Crookneck*, and *Warty Squashes* and *Gourds*, the last being the product of *Var. ovifera* (*C. ovifera*, L.), which has a slender stem with smaller leaves and small, hard, inedible, ornamental, egg-shaped, pear-shaped, or globular, and variously colored or striped fruit. July.

2. *C. moschàta*, DUCHESNE. CANADA CROOKNECK OR WINTER CROOKNECK S. A cultivated, running annual, probably from eastern Asia, with *bright green*, 5 to 7-lobed leaves, *downy with soft hairs*, as also the peduncles, which are deeply ridged and *conspicuously enlarged at their junction with the ripe fruit*, the latter also *with less thready pulp than No. 1*. Fruit pear-shaped, club-shaped, or cylindrical, often glaucous-whitish on the surface and with green stripes. Edible.

3. *C. máxima*, DUCHESNE. WINTER OR TURBAN SQUASH. An annual, of unknown nativity and of world-wide cultivation, with *orbicular or kidney-shaped leaves usually not lobed*. Corolla tube oblong, scarcely

widening at the top, and the lobes large, soft, and widely spreading. Peduncles soft and spongy, not enlarged next the ripe fruit, and not ribbed or grooved. Fruit rounded or ovate, with a firm, yellow or orange, not thready flesh. The parent of the HUBBARD S., BOSTON MARROW, etc.

V. CITRULLUS, SCHRAD. Prostrate, Old World vines, with 2 to 3-forked tendrils, and axillary, solitary, monœcious flowers. Calyx deeply 5-cleft, with short, bell-shaped tube and linear-lanceolate lobes. Corolla with 5 deep, wide-spreading lobes, adnate to the bottom of the calyx. Stamens with short filaments. Stigmas 3, kidney-shaped. Fruit fleshy, with a firm rind. Seeds many. Besides an obscure South African species, the one given below and the colocynth (*C. COLOCYNTHIS*) are all that are known.

1. *C. vulgaris*, SCHRAD. **WATERMELON.** A slender, hairy, prostrate annual, cultivated extensively in the Southern States and from prehistoric times in warm countries of the Old World. Leaves glaucous beneath, deeply 3 to 5-lobed, with the lobes sinuate-pinnatifid. Flowers pedunculate. Fruit globous or oval, smooth; the edible portion consisting of the reddish, enlarged, and juicy placenta containing the seeds. A form with very firm flesh used for preserving like true citron of commerce is the **CITRON MELON** or the so-called **CITRON** of the gardens. Flowers, June. Fruit, Aug., Sept.

VI. CUCUMIS, L. Creeping or climbing, Old World annuals or perennials, with simple tendrils, and axillary, yellow flowers; the fertile solitary and the sterile clustered. Calyx tubular-bell-shaped, with a 5-lobed limb. Corolla deeply 5-parted. Stamens 3, distinct. Style short. Stigmas 3, obtuse. Fruit with fleshy rind. Seeds not margined.

1. *C. sativus*, L. **CUCUMBER.** A rough, prostrate annual from southern Asia, with petioled, palmately 5-lobed leaves, the lobes acute and the middle one longest. Fruit short-stalked, generally elongated, prickly, at least when young, becoming smooth and usually shining. Seeds white. Eaten before maturity. Many varieties exist. June to Sept.

2. *C. Melo*, L. **MELON.** **MUSKMELON.** A prostrate annual from southern Asia, with rough, hairy, or prickly stem, usually roundish, heart-shaped, sometimes roundly lobed, denticulate leaves. Fruit ovate or subglobose, with a smooth rind and the sweet, edible flesh between it and the watery placenta containing the seeds.

Var. *Cantalupensis*, NAUD., is the **CANTALOUPE** or **ROCK MELON**, with more or less warty, often furrowed, fruits, the specific and common name being derived from Cantaluppi, a former country seat of the Pope, where it was first introduced from Armenia.

Var. *flexuosus*, NAUD., the **SNAKE CUCUMBER**, has a long, variously curved, greenish fruit, often 2° to 3° long and 1' to 3' in diameter.

3. *C. Anguria*, L. **WEST INDIAN** or **BURR GHERKIN.** An annual supposed to be tropical American, with slender, hispid stems, and rough, deeply 3 to 5-lobed, cordate leaves, the lobes narrowly obovate or spatulate. Flowers small, usually solitary, long-stalked. Fruit rough, spiny,

globose or ellipsoidal, 1' to 2' long. Cultivated as an oddity and also for pickles; not, however, the Gherkins of mixed pickles, which are young cucumbers. Called also *Gooseberry Gourd*.

ORDER 45. BEGONIACEÆ—BEGONIA FAMILY

Herbs or somewhat shrubby plants, with succulent stems, alternate, oblique, usually cordate or ovate-cordate leaves, large caducous stipules, and monœcious flowers in clusters on axillary peduncles. Sepals and petals similarly colored. Stamens many. Ovary inferior, 3-celled, with 3 large or double placentæ meeting in the axis, 3-winged or 3-angled, with 3 styles. Fruit a capsule with very many, minute seeds.

I. BEGONIA, L. ELEPHANT'S EAR. BEGONIA. Tropical plants, cultivated for ornament in houses, conservatories, etc., with characteristics mostly given in those of the family of which it is the main, if not the only, genus now recognized. Further: staminate and pistillate flowers usually in the same cluster; the former usually with 2 sepals and 2 petals; the latter with 2 sepals and 3 to 5 or sometimes no petals. Stamens with short filaments.

1. **B. Rex, Purz.** A stemless perennial from India, with a creeping, fleshy, subterranean rootstock, long, round, red, bristly leafstalks, and broad, ovate, cordate, oblique, hairy leaves 8' to 12' long, with toothed margins and a dark metallic, olive-green surface, ornamented with a broad silvery band running all round about 1' from the edge. Flowers rather large, pale rose-colored, in erect, branching, peduncled cymes. Capsules 3-angled, with 2 short wings and 1 long one. The principal parent of many ornamental-leaved begonias.

2. **B. Evansiana, Andr. (B. discolor, Willd.)** An old-fashioned, nearly hardy perennial from China and Japan, with smooth, branching, succulent stem, 2° high, and large, somewhat angular, oblique, cordate-ovate leaves, green and somewhat bristly-hairy above and red beneath, on red petioles. Flowers many, pink throughout except the yellow anthers and stigmas, on branching, axillary peduncles.

3. **B. manicata, Brown.** A winter-blossoming, hothouse plant from Mexico, with short, fleshy, twisted, erect or ascending stem, and obliquely cordate, ovate-acute, dentate-ciliate, thick, fleshy leaves, smooth and green on both sides, 6' to 8' long; the shining green nerves beneath and the upper part of the long petioles clothed with fleshy, scale-like hairs. Flowers many, small, pink, with 2 sepals, usually no petals, in loose panicles on long, naked peduncles. Capsule wings nearly equal.

4. **B. coccinea, Hook.** A somewhat shrubby plant from Brazil, with a tall, succulent, suberect stem, and oblique, ovate-oblong, angular, pointed leaves 4' to 6' long, glossy above and green on both sides, with red, wavy, toothed margins, on short petioles. Flowers deep coral-red on red pedicels in pendulous racemes. Male flowers 6'' wide, with 2 sepals and 2 petals; female with a very long ovary. Wings short, subequal. Summer.

5. *B. incarnata*, LINK AND OTTO. A winter-blooming, hothouse plant from Mexico, with smooth, fleshy, erect stem, 2° to 3° high, the nodes swollen, reddish, and spotted, and obliquely cordate, lanceolate, acuminate, toothed, green leaves on short, smooth petioles. Flowers many, rose-colored, drooping, large, the male 18" wide, with 2 sepals and 2 petals; female with 2 sepals and 3 petals.

6. *B. semperflorans*, LINK AND OTTO. A long-blooming plant from Brazil, with a stout, smooth, fleshy, erect, reddish-green stem, 6' to 18' high, and round-ovate, subcordate, acute, serrate-ciliate, smooth, shining, pale green leaves. Flowers white or rose-colored, in small clusters on axillary peduncles. Male flowers with 2 sepals and 2 petals; female with 2 sepals and 3 petals. Capsule green, with reddish-tinged wings; 1 long and 2 short ones. Summer and autumn.

ORDER 46. CACTACEÆ — CACTUS FAMILY

Fleshy plants, remarkable for their curious stems, their lack of leaves, which is supplied by their fleshy rind and their abounding, clustered spines. Flowers perfect, regular, sessile, terminal or lateral, usually showy, solitary, and ephemeral. Sepals and petals many, epigynous, imbricated in several rows, and gradually passing into one another. Stamens very many, with long filaments inserted on the base of the petals. Style 1, slender. Stigmas several or many. Ovary 1-celled, with several parietal placenta. Fruit a berry, usually fleshy. Seeds many. Except one species of *Rhipsalis*, the whole family — about 20 genera and 1000 species — belong originally to the New World.

Key to Genera

Stem jointed. Calyx tube not prolonged beyond the ovary	OPUNTIA	I
Stem jointed. Calyx tube extending beyond the ovary	PHYLLOCACTUS	II
Stem not jointed	CEREUS	III

I. *OPUNTIA*, TOURN. PRICKLY PEAR. Perennial, shrub-like plants, with jointed, branching stems, the joints mostly flattened and fleshy but ultimately becoming cylindrical and woody, and small, deciduous leaves subtending fascicles of barbed prickles and sometimes spines regularly arranged on the surface. Sepals and petals many, adnate to the ovary, not cohering in a tube beyond it, but spreading, the outer generally narrower than the inner. Stamens very many, in a dense central cluster. Stigma with 5 to 7 erect rays. Berry pear-shaped or egg-shaped, often prickly.

1. *O. vulgaris*, MILL. COMMON OR EASTERN P. P. Found in dry, sandy soils or on rocks near the coast from Mass. to Fla., and often cultivated.

Joints *pale green*, obovate to orbicular, 4' to 8' long. Leaves awl-shaped, *generally appressed*, 2'' to 3'' long; bristles short, *greenish* or *yellowish*; spines, when present, *usually solitary*. Flowers *pale yellow*, 2' to 3' wide, with 7 to 9 petals. Fruit obovoid, 12'' to 18'' long, red, edible. June to Aug.

2. *O. Rafinésqui*, ENGELM. WESTERN P. P. A plant similar to the preceding, found in similar habitats from Mich. to Minn. south to Tenn., Mo., and Tex., and also along the coast from Mass. to Fla. Joints *dark green*, broadly obovate to suborbicular, 3' to 5' long. Leaves *spreading*, 8'' to 5'' long; bristles *reddish-brown*; spines 1 to 4, with one 9'' to 12'' long. Flowers 30'' to 40'' wide, *yellow*, often reddish at the center, with 10 to 12 petals. Fruit club-shaped, 18'' to 24'' long, not spiny, edible. Several varieties are cultivated. June to Aug.

3. *O. Missouriënsis*, DC. A very variable, prostrate plant, in prairies and dry soils from Wis. to Mo. and westward. Joints *light green*, broadly obovate to orbicular, 2' to 6' long, flat, tubercled, and covered with clusters of 5 to 10 slender, radiating spines 1' to 2' long, in tufts of fine, whitish bristles, subtended by leaves 1'' to 2'' long. Flowers light yellow, 2' to 3' wide. Fruit broadly ovate to subglobose, dry, very prickly, 1' or more long, inedible. May, June.

II. *PHYLLOCÁCTUS*, LINK. Shrubby, tropical plants, with jointed, flat stems and branches, the joints of the stems becoming cylindrical with age, *all the joints crenate or notched on the margins and the notches bearing flowers*. Calyx tube long, slender, smooth; lobes remotely scattered, colored. Petals many, rarely few, spreading. Stigma many-rayed. Fruit baccate, angular, smooth, ribbed. Of about a dozen recognized species, those in common cultivation have so hybridized that accurate description of them is scarcely practicable.

1. *P. Ackermánni*, LINK. A handsome plant from Mexico, cultivated in many varieties, with numerous flat, deeply crenate stems, sometimes 3' long, with branches 1' or less. Flowers 6' to 8' wide, with very short tube, rich, crimson shining petals, the outer ones lighter-colored, and long, curved stamens almost hiding the stigma.

III. *CÈREUS*, DC. Shrubs or trees, fleshy when young, many of them becoming woody with age, remarkable for the variety and grotesqueness of their forms as well as for the beauty of their flowers. Their forms range from erect, columnar, and tree-like to almost globular and to creeping and climbing; in most, if not all, however, with *stems ribbed, fluted, or angled lengthwise*, and armed with *radiating spines regularly arranged in clusters along the ridges or angles*. Flowers often nocturnal. Calyx tube much produced beyond the ovary; lobes many, spirally imbricated; the exterior scale-like, the interior elongated. Petals indefinite, spreading. Fruit scaly. The largest cactuses belong to this genus, which includes the *Giant Cactus* (*Cereus gigantëus*) of Arizona and Lower California.

1. *C. speciosissimus*, DC. A tropical, American plant, with creeping, climbing, spreading, or sometimes erect, 3 to 5-winged or -angled stems, 2° to 6° long, 1' to 2' in diameter. The serrated wings bear fascicles of 5 to 8 stiff, slender spines, seated in white, woolly tufts. Flowers 4' to 8' wide, with white stamens and crimson or scarlet petals of various shades, dazzlingly lustrous in sunshine and lasting several days when cut and placed in water. July to Aug.

2. *C. grandiflorus*, DC. COMMON NIGHT-BLOOMING CEREUS. A tropical American plant, with terete, slightly ribbed stem, about 1' in diameter, and long, flexuous, rooting and climbing branches. Spines short, fascicled in tufts of white bristles. Flowers lateral and terminal, very fragrant, 6' to 9' wide, opening after nightfall and closing finally before daybreak. Calyx tube clothed with long bristles. Sepals yellow within, slender, spreading. Petals pure white, broad, ascending, often cup-like around the long, yellow stamens. June to Aug.

ORDER 47. UMBELLIFERÆ — PARSLEY FAMILY

Herbs, with usually hollow and striate stems, alternate, mostly compound leaves, the petioles often sheathing, and small flowers generally in umbels, rarely in heads. Calyx tube adnate to the ovary, the limb with 5 teeth, often obsolete or inconspicuous. Petals 5, usually with an incurved tip, inserted with the 5 alternate stamens in the epigynous disk. Styles 2, often with a thickened, cushion-like base called the stylopodium. Ovary inferior, 2-celled. Fruit dry, consisting of 2 cohering akenes, called mericarps, which separate when ripe along their inner face, called the commissure, and hang supported at the top by the slender, simple, or forked axis between them, called the carpophore. Each carpel is nearly always furnished with 5 longitudinal, primary ribs, and sometimes 4 secondary ones between them, often with tubular receptacles, called vittæ, or oil tubes, and containing an aromatic oil, just beneath the surface between the primary ribs and sometimes along the commissure. These show best in slices across the fruit. Seeds solitary, suspended. Umbels mostly compound, the secondary ones being called umbellets, while the whorls of bracts which often subtend the general and secondary umbels are called respectively involucre and involucels. A large family, embracing innocent, aromatic, and poisonous plants. The flowers are so much alike in all, that the genera are determinable only by the fruit, and, in most cases, are entirely too difficult

for beginners. A few only, accordingly, are here given of the most common and most easy.

Key to Genera

Leaves simple, narrow. Flowers in heads	ERYNGIUM	I
Leaves simple, ovate and perfoliate	BUPLEURUM	II
Leaves palmately compound. Umbellets capitate	SANICULA	III
Leaves ternately or pinnately compound, decompound or dissected. (a)		
a. Fruit with prickly secondary ribs. Leaves dissected	DAUCUS	IV
a. Fruit with no secondary ribs. (b)		
b. All the ribs bristly. Fruit slender, club-shaped. Flowers white	OSMORRHIZA	V
b. All the ribs winged. Fruit terete. Flowers yellow	THASPIUM	VI
b. Only lateral ribs winged. Fruit flattened dorsally. (c)		
b. None of the ribs winged or bristly. (d)		
c. Flowers yellow	PASTINACA	VIII
c. Flowers white; outer ones larger and irregular	HERACLEUM	IX
c. Flowers white or greenish; all alike	ANGELICA	X
d. Flowers yellow	ZIZIA	VII
d. Flowers white or whitish. (e)		
e. Nearly stemless herbs, with ternately decompound leaves	ERIGENIA	XI
e. Stout marsh herbs. Leaflets lanceolate, serrate	CICUTA	XII
e. Tall herbs, with spotted stems and no oil tubes	CONIUM	XIII
e. Cultivated herbs, with ultimate leaf segments linear	CARUM	XIV

I. ERYNGIUM, Tourn. ERYNGO. Smooth herbs, usually perennial, with coriaceous, spiny, more or less sheathing leaves, and small, white or blue, sessile, bracted flowers in dense, oblong or roundish heads; the lower bracts usually much larger, and forming an involucre to the head. Calyx teeth conspicuous, rigid, persistent. Styles long, slender. Stylopodium wanting. Fruit ovoid, scaly, or tuberculate, without ribs, usually with 3 dorsal oil tubes and 2 next the commissure.

1. *E. yuccæfolium*, Mx. (*E. AQUATICUM*, L.) RATTLESNAKE MASTER. BUTTON SNAKE-ROOT. A smooth, glaucous perennial, with stout, striate, simple, or branched stem, 2° to 6° high, found in wet or dry soils from the pine barrens of N.J. to Minn. south to Fla. and Tex. *Leaves* rigid, mostly with clasping base, broadly linear, acuminate, *parallel-veined*, 1° to 2° long, fringed with remote bristles. Flowers white, inconspicuous, with ovate-lanceolate, entire, *cuspidate bractlets*, in ovoid-globose, peduncled heads 7" to 10" long, subtended by *involucrate bracts*, similar to the bractlets, and *shorter than the heads*. June to Sept.

2. *E. Virginianum*, LAM. A tall, slender perennial or biennial (?), with hollow stem, 3° to 4° high, branching above, found in marshes or on the margins of ponds and streams near the coast from N.J. to Fla. west to Tex. *Leaves reticulate-veined*; upper ones sessile, clasping, linear, 2' to 8' long, spiny-toothed, or laciniate; lower and radical ones linear to oblong-lanceolate, entire or denticulate, on long, hollow petioles. Flowers pale blue or white, with *tricuspidate bractlets* in subglobose heads 4" to 6" long, subtended by spiny-toothed *involucrate bracts longer than the heads*. July to Sept.

II. BUPLEURUM, L. Smooth, annual or perennial herbs or shrubby plants, with simple, entire leaves and yellowish flowers

in compound umbels. Calyx teeth obsolete. Fruit flattened laterally, ovate-oblong. Carpels 5-ribbed. Stylopodium prominent, flat. Oil tubes wanting or continuous about seed cavity.

1. *B. rotundifolium*, L. HARE'S-EAR. THOROUGHWAX. A European annual, with erect, branching stem, 1° to 2° high, naturalized and very common in fields and cultivated grounds from N.Y. to S. Dak. south to N.C. and Ark. *Leaves roundish-ovate*, obtuse, mucronate, *perfoliate*, 1' to 3' long, very smooth. Flowers small, yellow. Involucre none. Involucels of 5 ovate, mucronate bracts longer than the umbellets. Fruit with slender ribs and no oil tubes. Umbels 5 to 9-rayed. Called also *Thoroughwort* and *Modesty*. July, Aug.

III. *SANÍCULA*, L. SANICLE. Herbs, mostly smooth perennials, with mostly palmately compound leaves and greenish-yellow, white, or purplish flowers. Umbels nearly simple, with few rays and the umbellets in heads. Flowers perfect and staminate, sessile and pediceled. Calyx teeth distinct, persistent. Fruit subglobose, covered with hooked bristles, or tuberculate. Stylopodium and ribs wanting. Oil tubes present.

1. *S. Marilandica*, L. BLACK SNAKE-ROOT. A rather stout perennial, 1° to 3° high, of rich woods and thickets from Me. to Dak. south to Ga., Tenn., and Kan. *Leaves digitately 5 to 7-parted*, with oblong or oblanceolate, incisely serrate segments 2' to 5' long; radical ones long-petioled; cauline sessile or nearly so. Involucre of 5 to 6 leaf-like bracts; involucels bractlets. *Staminate flowers many, pediceled, sometimes in separate heads*; fertile ones sessile. *Styles slender, longer than the bristles, recurved*. Umbels often proliferous. May to July.

2. *S. Canadensis*, L. A perennial, 1° to 4° high, common in dry woods from Mass. to Neb. south to Fla. and Tex. It differs from No. 1 in having the *staminate flowers few and shorter than the fertile, never in separate heads*; the *fruit smaller and the styles shorter than the bristles*. Stem leafy, with petioled, 3 to 5-parted leaves; segments ovate, mucronate-serrate, thin, 1' to 3' long. June to Aug.

IV. *DAÛCUS*, L. Bristly annuals or biennials, with pinately decomposed leaves, leafy and cleft, involucre bracts, and usually white flowers in compound umbels. Calyx teeth obsolete. Petals with inflected point; the 2 outer often larger. Fruit oblong, flattened dorsally. Carpels with 5 slender, bristly, primary ribs, and 4 more prominent, secondary ones, winged and bearing a row of barbed prickles. Stylopodium depressed or wanting. Oil tubes 4 beneath the secondary ribs; 2 next the commissure.

1. *D. Carota*, L. WILD CARROT. An Old World biennial, said to be the original of the cultivated carrot, naturalized as a weed in fields and waste places everywhere. Stem erect, 1° to 3° high, hispid, branching. Leaves 2 to 3-pinnately divided, with *ultimate segments linear or lanceolate and cuspidate*. Umbels dense, 2' to 4' wide, concave, connivent when mature, *suggesting a bird's nest*. Flowers white; central one

of the umbel generally purple. Often called also *Queen Anne's Lace* and *Bird's Nest*.

V. OSMORRHIZA, Raf. Smooth to hirsute perennials, from thick, aromatic roots, 1° to 3° high, with ternately decompound leaves, and white or purple flowers in few-rayed and few-fruited umbels. Calyx teeth obsolete. Petals oblong, point inflexed. Fruit linear to oblong, tapering at base, with 5 equal, bristly ribs. Stylopodium conical or depressed. Oil tubes obsolete in mature fruit.

1. *O. longistylis*, DC. SWEET CICELY. A stout, slightly pubescent, at length smooth perennial, 1° to 3° high, from *sweet, aromatic roots*, common in woods from Me. to Dak. south to Ala., Tenn., and Kan. Leaves 2 to 3-ternate, leaflets 2' to 3' long, acuminate, cleft, and toothed. Umbels with 4 to 6 stout rays 1' to 2' long; pedicels 3'' to 10'' long. Fruit blackish, 6'' long, 1'' wide, crowned with the slender, conical stylopodium and the filiform, persistent styles 1'' long or more. Root of an agreeable, spicy flavor. The leaves also, when bruised, give off a spicy odor. May, June.

2. *O. brevistylis*, DC. A perennial, common in woods from Me. to Minn. south to N.C. and Ala., similar to the preceding, but *villous-pubescent in all its parts*, and with the *styles short and convergent*. The root also is less spicy in flavor or disagreeable. May, June.

VI. THASPIUM, Nutt. MEADOW PARSNIP. Perennials, with ternately compound leaves, or the lower ones simple, broad, serrate, or toothed leaflets, and yellow or purple flowers in compound umbels, usually with no involucre, and the involucre of small bracts. Calyx teeth conspicuous. Fruit ovoid to oblong. Carpels with some or all of the ribs strongly winged. Stylopodium wanting. Styles long. Oil tubes solitary between the ribs and 2 next the commissure.

1. *T. aureum*, Nutt. GOLDEN ALEXANDERS. A smooth perennial, 1° to 2° high, in thickets and woodlands from New Eng. to Ga. and westward. Radical leaves mostly cordate, *serrate*. Stem leaves 1-ternate, rarely 2-ternate; leaflets ovate to lanceolate, *serrate*, 1' to 2' long, with round or tapering base. Flowers deep yellow. Fruit globose-ovoid, about 2'' long, with *all the ribs strongly winged*. Very variable. June, July. Var. *trifoliatum*, Coult. and Rose, 1887, with *crenate or crenately-toothed leaves and leaflets*, is common from Ohio westward. Var. *atropurpureum*, Coult. and Rose, 1887, with dark purple flowers, occurs through the same range as the type.

2. *T. barbinode*, Nutt. HAIRY-JOINTED MEADOW PARSNIP. A loosely branched, erect perennial, 2° to 4° high, with *pubescent joints*, found along streams from N.Y. to Minn. south to Fla., Ky., and Kan. Stem angular, grooved. Leaves 1 to 3-ternate, 2' to 6' long; leaflets mostly ovate, acute, coarsely toothed or incisedly serrate, with entire cuneate base, or sometimes ternately cleft or parted. *Flowers pale yellow*. Fruit broadly oblong, about 3'' long, with 6 or 7 of the ribs strongly winged. May, June.

VII. ZÍZIA, KOCH. Smooth perennials, resembling those of *Thaspium* in leaves, simple to ternately compound; in umbels without involucre and with involucels of small bractlets, and in their yellow flowers. They have, however, the *central flower and fruit of each umbellet sessile*. In calyx teeth, fruit, styles, and stylopodium they are also similar; but the carpels have prominent *filiform ribs not at all winged*, and an additional small oil tube in each rib.

1. *L. aërea*, KOCH. **EARLY MEADOW PARSNIP OR GOLDEN ALEXANDERS.** An erect perennial, 1° to 3° high, flowering in early spring in open prairies and upland meadows from Me. to S. Dak. south to Fla. and Tex. Uppermost leaves 1-ternate, on short-winged petioles; lower and radical ones 2 to 3-ternate on long petioles. Leaflets in all oblong-ovate to lanceolate, sharply serrate. Rays about 20, stiff, ascending, unequal, 1' to 2' long. Fruit oblong, about 2'' long. April to June.

VIII. PASTINÀCA, L. Tall, smooth, stout, Old World biennials or annuals, with thick roots, pinnately compound leaves, and yellow flowers in compound umbels; involucre and involucels usually wanting. Calyx teeth obsolete. Stylopodium depressed. Fruit oval, *greatly flattened dorsally*; dorsal ribs very weak; *lateral ones strongly winged*, and *those of the 2 carpels lying close together making the fruit 2-winged*. Oil tubes solitary between the ribs; 2 to 4 next the commissure; all about half as long as the carpels.

1. *P. sativa*, L. **PARSNIP.** A robust, European biennial or annual, with angular, furrowed stem, 3° to 5° high, cultivated for its fleshy, spindle-shaped root since the days of ancient Rome and naturalized as a common weed in waste places everywhere in our area. Leaves downy beneath, odd-pinnate; lower and radical ones petioled, 12' to 18' long, with 3 to 4 pairs of sessile, oblong, sharply toothed and cut leaflets, the terminal one 3-lobed. Flowers yellow, small, in large, terminal umbels. Fruit 2'' to 3'' long, flat. In its wild state the root is hard, diminished in size, acrid, and *poisonous*. June to Sept.

IX. HERACLÉUM, L. Cow PARSNIP. Tall, stout perennials, with large, ternately compound leaves, and compound umbels of white flowers. Bracts of involucre deciduous or none; those of the involucels many and linear. Calyx teeth small, acute, or obsolete. Petals obcordate, with inflexed point; often with the outer ones larger and 2-cleft. Stylopodium thick, conical. *Fruit, ribs, and oil tubes the same as in Pastinaca.*

1. *H. lanatum*, Mx. **AMERICAN C. P.** A very stout, coarse, woolly-pubescent perennial, 4° to 8° high, of wet grounds from Me. to Dak. south to N.C., Tenn., and Mo. Stem furrowed, branching. Leaves on much dilated, channeled petioles, ternate; leaflets stalked, round-

cordate, 3' to 8' wide, irregularly cut-lobed and serrated. Umbels 6' to 12' wide, with 10 to 30 stout rays. Fruit broadly oval, 4'' to 6'' long, somewhat pubescent. June, July.

X. ANGÉLICA, L. Stout perennials, with usually ternate-pinnately compound leaves, and mostly white flowers in large, terminal, compound umbels. Involucre none or scanty. Involucels of small bractlets or none. Calyx teeth obsolete. Petals with inflexed tip. Fruit very much flattened dorsally; all the ribs strong; lateral ones also broadly winged; those of the 2 carpels divergent, making the fruit 4-winged, thus differing from *Pastinaca* and *Heracleum*. Stylopodium conical. Oil tubes 1 to several between the ribs; 2 to 10 next the commissure.

1. **A. villôsa, WALT.** (*ARCHANGÉLICA HIRSÛTA, TORR. AND GRAY.*) PUBESCENT ANGELICA. A somewhat slender, erect perennial, 2° to 5° high, found in rocky woods and dry soils from Conn. to Minn. south to Fla., Miss., and Mo. Stem striate, with the upper part and the umbels tomentose or pubescent. Leaves on petioles 6' to 10' long, 2 to 3-ternately or 2 to 3-pinnately divided, with thickish, lanceolate to oblong, serrate leaflets 1' to 2' long. Umbels 2' to 4' wide, on long, velvety peduncles; with 7 to 30 slender rays 1' to 2' long. Fruit broadly oval, 2'' to 3'' long, pubescent, with lateral wings as broad as the carpels. Oil tubes usually several between the ribs. July, Aug.

2. **A. atropurpûrea, L.** GREAT OR PURPLE-STEMMED A. A very stout, smooth, strong-scented perennial, with glaucous, furrowed, dark purple stem, 4° to 6° high, in swampy and moist grounds and along low river banks from Me. to Minn. south to Del. and Ill. Leaves on large, inflated, channeled petioles ternately, then pinnately, compound, with 5 to 7 thin, ovate, sharply cut, mucronate-serrate leaflets 1' to 2' long. Umbels with 10 to 25 rays 1' to 3' long, no involucre, and involucels, a few short, subulate bractlets. Flowers greenish-white. Fruit oblong, smooth, 3'' long; lateral wings half as wide as the carpel. Oil tubes 25 to 30, continuous; 8 to 10 next the commissure. One of the largest of the *Umbelliferae*, noted for aromatic properties. June, July.

XI. ERIGENIA, NUTT. A low, smooth, nearly stemless perennial, from a deep tuber, with ternately decompound leaves, and white flowers in small, compact, compound umbels. Calyx teeth obsolete. Petals flat, entire, obovate or spatulate. Fruit flattened laterally, nearly orbicular, notched at apex and base by the incurving of the nearly kidney-shaped carpels. Ribs 5, slender. Oil tubes several between the ribs, 9 to 11 next the commissure. Seed face concave lengthwise and crosswise. A monotypic genus named from its early flowering, *Spring-born*.

1. **E. bulbôsa, NUTT.** HARBINGER OF SPRING. PEPPER AND SALT. A hardy and interesting little plant, of the earliest spring, 4' to 6' high, on shady banks from western N.Y. to Wis. and southeastern Minn. south to Md., Ala., and Kan. Leaves 2 to 4; lowest one radical, 3-ternately decom-

pound, ultimate segments oblong; upper ones similar but 2-ternate and involucre to a 2 to 4-rayed umbel of *white flowers*, with dark brown or purple anthers, the occasion of one of its popular names. March, April.

XII. CÍCŪTA, L. WATER HEMLOCK. COWBANE. Tall, smooth, *poisonous*, marsh perennials, with pinnately compound leaves, serrate leaflets, and white flowers in compound, terminal umbels; involucre usually wanting, involucels of several small bractlets. Calyx teeth pointed, prominent. Petals obcordate, tips inflexed. Fruit flattened laterally, oblong to orbicular, smooth, with 10 strong, flattish ribs. Oil tubes solitary between the ribs; 2 next the commissure in each carpel. Stylopodium low.

1. *C. maculata*, L. AMERICAN W. H. OR C. An erect, branching herb, 3° to 6° high, with *stout, hollow stem streaked with purple*, found in swamps and low grounds from Me. to Dak. south to Fla. and Mo. Roots several, fleshy, clustered, ovoid or oblong, *poisonous* tubers. Leaves large, triangular in outline, 2 to 3-pinnate, lower ones long-petioled; leaflets thin, lanceolate to elliptic-lanceolate, 2' to 5' long, coarsely and sharply serrate; the veins ending in the notches. Fruit ovoid or oval, 2" long, crowned with the persistent calyx and styles. July, Aug.

2. *C. bulbifera*, L. BULB-BEARING W. H. A slender, very branching herb, 1° to 3° high, with a *terete, green, striate stem*, common in swamps and wet meadows from Me. to Del. west to Ind., Iowa, and Minn. Leaves 2 to 3-pinnate, or sometimes apparently ternate, with *linear, sparingly toothed leaflets* 1' to 2' long; *upper leaves with bulblets* clustered in their axils (*bulbifera*). Fruit seldom maturing, 1" long. July to Sept.

XIII. CONIUM, L. POISON HEMLOCK. Tall, smooth, *poisonous*, Old World biennials, with large, decompound leaves and small white flowers in compound umbels; involucre and involucels of 3 to 5 narrow bracts, those of the involucels one-sided. Calyx teeth obsolete. Petals obcordate with inflexed point. Stylopodium conical. Fruit broadly oval, smooth, slightly flattened laterally *with strong, wavy, crenulate ribs and no oil tubes*. An African species and the one below make up the genus.

1. *C. maculatum*, L. A branching herb, with a shining, hollow, *purple-spotted stem*, 2° to 5° high, naturalized from Europe in waste places from Me. to Iowa and Minn. south to Del. and Ind. Lower and radical leaves petioled, upper ones nearly or entirely sessile; all 2 to 3-pinnate, with thin, ovate or lanceolate, pinnatifid leaflets of a nauseous odor when bruised. Fruit about 1" wide, the wavy ribs conspicuous when dry. A virulent poison, used in medicine, and supposed to be the hemlock of the infusion used by the ancient Greeks in capital punishment, whence the generic name. July, Aug.

XIV. CÀRUM, L. Smooth, slender, erect herbs, with pinnate or pinnatifid leaves, and compound umbels of white or yellow-

ish flowers. Calyx teeth minute. Petals obovate, with inflexed point. Stylopodium conical. Fruit ovate or oblong, flattened laterally, smooth; ribs filiform or inconspicuous; oil tubes solitary between the ribs; 2 to 6 next the commissure.

1. **C. Cárui**, L. CARAWAY. A European biennial or annual, sometimes perennial, 1° to 2° high, cultivated for its aromatic fruit ("seeds") used in cookery, and sometimes for its edible young shoots and leaves, and somewhat escaped and naturalized. Stem smooth, striate, branched, 1° to 2° high. Leaves pinnately compound, with very many, linear segments; radical and lower ones long-petioled, the latter with clasping sheaths; the uppermost nearly sessile. Flowers white. Umbels 1' to 3' wide, on long peduncles, with 7 to 10 rays 8" to 12" long. Involucre of 1 to 3 linear bracts, or wanting, involuclers usually none. Fruit, "caraway seed," oblong, about 2" long. May to July.

ORDER 48. ARALIACEÆ — GINSENG FAMILY

Herbs, shrubs, or trees, closely allied to the *Umbelliferae* in leaves, inflorescence, and flowers, *but with the styles and cells of the ovary usually more than 2, generally 3 to 5*. Cells 1-ovuled. Fruit a 3 to 5-celled berry or drupe. Seeds albuminous.

Key to Genera

Leaves alternate, pinnate. Umbels more than one	ARALIA	I
Leaves whorled, palmate. Umbel only one	PANAX	II
Leaves simple. Umbels more than one. Climbers	HEDERA	III

I. **ARALIA**. Perennial herbs, shrubs, or trees, with alternate, decompound leaves, and small, white or greenish, mostly perfect flowers in several to many, simple umbels, variously arranged. Flowers somewhat polygamous. Calyx tube adherent, limb 5-toothed or nearly obsolete. Petals 5, spreading, epigynous, alternate, with the 5 epigynous stamens. Styles 5. Fruit a 5-celled, 5-seeded berry crowned with the styles, usually 5-lobed when dry.

Plants 1° to 3° high, with 2 to 7 terminal or corymbed umbels	Nos. 1, 2
Plants 8° to 12° high, with many panicled or racemed umbels	Nos. 3, 4

1. **A. nudicaulis**, L. WILD SARSAPARILLA. SMALL SPIKENARD. A nearly stemless, perennial herb, of rich, rocky soils and moist woodlands from Me. to Dak. south to N.C. and Mo. Leaf usually solitary, from a very short stem rising from a horizontal rootstock often 2 or 3 feet long, on a long petiole, ternately, then pinnately 3 to 5-foliolate, the ternate divisions distinctly stalked, the leaflets sessile or nearly so, oval or ovate, finely serrate, 2' to 5' long. Peduncle scape-like, shorter than the petiole, supporting usually 3 small umbels of greenish flowers, in fruit purplish-black, globose berries about 3" long, lobed when dry. Roots aromatic and used as a substitute for officinal sarsaparilla. May, June.

2. *A. hispida*, L. BRISTLY S. WILD ELDER. A half-shrubby perennial, common in rocky or sandy places in woods or fields from Me. to Minn. south to N.C. and Ind. Stem 1° to 2° high, woody, and beset with sharp, stiff bristles below, herbaceous and branching above. Leaves bipinnate; leaflets ovate or oval, cut-serrate, 1' to 2' long. Umbels many, corymbed, on a long peduncle. Flowers white. Berries dark purple, globose, about 3'' wide, strongly lobed when dry. June, July.

3. *A. racemosa*, L. AMERICAN SPIKENARD. SPIGNET. A smooth, perennial herb, with dark green or reddish stem, 3° to 4° high, from a large, thick, aromatic root, found in rich, rocky woods from Me. to Minn. south to Ga. and Mo. Leaves ternate, with pinnately 3 to 5-foliolate divisions; leaflets broadly ovate, cordate, acuminate, doubly and sharply serrate, 2' to 6' long, thin, slightly downy. Umbels many, in a panicle of racemes. Flowers greenish. Berries globose, about 3'' long, reddish-brown or purple. The spicy root is used in flavoring beverages. The ancient spikenard of the Bible is supposed to be the East Indian S. (*Nardostachys Jatamansi*) of the Valerian Family.

4. *A. spinosa*, L. ANGELICA TREE. HERCULES'S CLUB. A shrub or small tree, 8° to 30° high, with very prickly stem, branches, and petioles, found in low, damp woods or along streams from southern N.Y. to Mo. south to Fla. and Tex. Trunk usually simple, bearing all the leaves and panicles at or near the top, like a palm tree. Leaves bipinnate, 18' to 30', sometimes 3° to 4° long, on long petioles; leaflets ovate, acuminate, serrate, dark green above, pale and glaucous beneath, 1' to 4' long. Umbels many, in large, terminal, compound panicles. Flowers white. Berries black, ovoid, 3'' long. June to Aug.

II. *PANAX*, L. Perennial herbs in our species, with a whorl of 3-petioled, palmately compound leaves at the top of the simple stem, and a single, terminal, peduncled umbel of greenish or white, diœciously polygamous flowers. Calyx tube adherent; limb obscurely 5-toothed. Petals 5, alternate, with the 5 epigynous stamens. Styles 2 to 3. Fruit a 2 to 3-seeded, drupe-like berry. (*ARALIA* of Gray's Manual.)

1. *P. trifolium*, L. GROUND NUT. DWARF GINSENG. A smooth herb, 4' to 8' high, common in low, rich woods and thickets from Me. to Minn., Iowa, and Ill. south to Ga. Root globular, about 6'' in diameter, deep in the ground, of a pungent flavor. Petioles 1' to 2' long. Leaflets 3 to 5, generally 3, sessile, oblong to oblanceolate, obtuse, serrate, 1' to 2' long. Flowers white, styles 3; fertile and barren on different plants; the former without stamens, the latter with a single abortive style. Berries green or yellowish, 3-seeded. April to June.

2. *P. quinquefolium*, L. GINSENG. A smooth herb, 8' to 15' high, found in rich, rocky or mountain woods from Me. to Minn. and Neb. south to Ala. and Mo. Root spindle-shaped, 4' to 9' long, simple or forked, fleshy, aromatic. Leaflets 5 to 7, generally 5, thin, petioled, oval or obovate, acuminate, serrate, 2' to 5' long. Flowers greenish-yellow, styles 2; barren ones on separate plants with large petals. Berries bright crimson. The root is regarded by the Chinese as a panacea. July, Aug.

III. *HEDERA*, L. Old World, shrubby plants, climbing or erect, with exstipulate, evergreen leaves, and polygamous flowers in paniced umbels. Calyx 5-toothed. Petals 5. Stamens

5. Style 1, with 5 obscure stigmas. Berry 5-seeded. A small, greenhouse tree, with pinnate leaves, from Australia is the only species besides the one given below.

1. *H. Hælix*, L. COMMON ENGLISH OR EUROPEAN IVY. An evergreen shrub, climbing high on walls and trees by numerous radicating fibers, native in Great Britain and the entire Mediterranean region, and now cultivated everywhere in our area. Leaves thick, shining, dark green with whitish veins, petioled, roundish-ovate, 3 to 5-angled; upper ones ovate. Flowers yellowish-green, with 5 broad, short petals, in corymbed umbels. Berries black. Scores of varieties are cultivated.

ORDER 49. CORNACEÆ — DOGWOOD FAMILY

Shrubs or trees, rarely herbs, with opposite or alternate, exstipulate, simple leaves, and perfect, polygamous or dioecious, regular flowers, mostly in cymose clusters or in involucrate umbels or heads. Calyx adherent to the ovary; limb minute, 4 to 5-toothed or -lobed. Petals 4 to 5, distinct, often wanting, usually valvate in the bud, and inserted with the alternate stamens on the margin of the epigynous disk in the perfect flowers. Style 1. Ovary 1 to 2-celled. Fruit a berry-like drupe crowned with the calyx.

Key to Genera

Flowers 4-merous, perfect, complete **CORNUS** I
Flowers 5-merous, polygamous or dioecious, often apetalous **NYSSA** II

I. *CORNUS*, L. CORNEL. DOGWOOD. Shrubs, trees, or rarely low herbs, with mostly opposite, usually entire and pinnately veined leaves, and small flowers in open, panicle cymes or in involucrate umbels or heads. Flowers perfect, except in a few foreign species. Calyx limb of 4 minute teeth. Petals 4. Stamens 4. Style slender or club-shaped. Ovary 2-celled. Drupe small; stone 2-celled, 2-seeded. Bark bitter, tonic.

Flowers in a head subtended by 4 large petaloid bracts Nos. 1, 2
Flowers in an umbel subtended by 4 small bracts No. 3
Flowers in naked cymes. (a)
 a. Leaves alternate No. 4
 a. Leaves opposite. (b)
 b. Twigs and cymes pubescent Nos. 5, 6
 b. Twigs and cymes smooth. (c)
 c. Drupes blue No. 7
 c. Drupes white Nos. 8, 9

1. *C. speciosissimus*, DC. A tropical, American plant, with creeping, climbing, spreading, or sometimes erect, 3 to 5-winged or -angled stems, 2° to 6° long, 1' to 2' in diameter. The serrated wings bear fascicles of 5 to 8 stiff, slender spines, seated in white, woolly tufts. Flowers 4' to 8' wide, with white stamens and crimson or scarlet petals of various shades, dazzlingly lustrous in sunshine and lasting several days when cut and placed in water. July to Aug.

2. *C. grandiflorus*, DC. COMMON NIGHT-BLOOMING CEREUS. A tropical American plant, with terete, slightly ribbed stem, about 1' in diameter, and long, flexuous, rooting and climbing branches. Spines short, fascicled in tufts of white bristles. Flowers lateral and terminal, very fragrant, 6' to 9' wide, opening after nightfall and closing finally before daybreak. Calyx tube clothed with long bristles. Sepals yellow within, slender, spreading. Petals pure white, broad, ascending, often cup-like around the long, yellow stamens. June to Aug.

ORDER 47. UMBELLIFERÆ — PARSLEY FAMILY

Herbs, with usually hollow and striate stems, alternate, mostly compound leaves, the petioles often sheathing, and small flowers generally in umbels, rarely in heads. Calyx tube adnate to the ovary, the limb with 5 teeth, often obsolete or inconspicuous. Petals 5, usually with an incurved tip, inserted with the 5 alternate stamens in the epigynous disk. Styles 2, often with a thickened, cushion-like base called the stylopodium. Ovary inferior, 2-celled. Fruit dry, consisting of 2 cohering akenes, called mericarps, which separate when ripe along their inner face, called the commissure, and hang supported at the top by the slender, simple, or forked axis between them, called the carpophore. Each carpel is nearly always furnished with 5 longitudinal, primary ribs, and sometimes 4 secondary ones between them, often with tubular receptacles, called vittæ, or oil tubes, and containing an aromatic oil, just beneath the surface between the primary ribs and sometimes along the commissure. These show best in slices across the fruit. Seeds solitary, suspended. Umbels mostly compound, the secondary ones being called umbellets, while the whorls of bracts which often subtend the general and secondary umbels are called respectively involucre and involucl. A large family, embracing innocent, aromatic, and poisonous plants. The flowers are so much alike in all, that the genera are determinable only by the fruit, and, in most cases, are entirely too difficult

for beginners. A few only, accordingly, are here given of the most common and most easy.

Key to Genera

Leaves simple, narrow. Flowers in heads	ERYNGIUM	I
Leaves simple, ovate and perfoliate	BUPLEURUM	II
Leaves palmately compound. Umbellets capitate	SANICULA	III
Leaves ternately or pinnately compound, decomposed or dissected. (a)		
a. Fruit with prickly secondary ribs. Leaves dissected	DAUCUS	IV
a. Fruit with no secondary ribs. (b)		
b. All the ribs bristly. Fruit slender, club-shaped. Flowers white	OSMORRHIZA	V
b. All the ribs winged. Fruit terete. Flowers yellow	THASPIUM	VI
b. Only lateral ribs winged. Fruit flattened dorsally. (c)		
b. None of the ribs winged or bristly. (d)		
c. Flowers yellow	PASTINACA	VIII
c. Flowers white; outer ones larger and irregular	HERACLEUM	IX
c. Flowers white or greenish; all alike	ANGELICA	X
d. Flowers yellow	ZIZIA	VII
d. Flowers white or whitish. (e)		
e. Nearly stemless herbs, with ternately decomposed leaves	ERIGENIA	XI
e. Stout marsh herbs. Leaflets lanceolate, serrate	CICUTA	XII
e. Tall herbs, with spotted stems and no oil tubes	CONIUM	XIII
e. Cultivated herbs, with ultimate leaf segments linear	CARUM	XIV

I. ERYNGIUM, Tourn. ERYNGO. Smooth herbs, usually perennial, with coriaceous, spiny, more or less sheathing leaves, and small, white or blue, sessile, bracted flowers in dense, oblong or roundish heads; the lower bracts usually much larger, and forming an involucre to the head. Calyx teeth conspicuous, rigid, persistent. Styles long, slender. Stylopodium wanting. Fruit ovoid, scaly, or tuberculate, without ribs, usually with 3 dorsal oil tubes and 2 next the commissure.

1. E. yuccæfolium, Mx. (E. AQUATICUM, L.) RATTLESNAKE MASTER. BURTON SNAKEROOT. A smooth, glaucous perennial, with stout, striate, simple, or branched stem, 2° to 6° high, found in wet or dry soils from the pine barrens of N.J. to Minn. south to Fla. and Tex. *Leaves* rigid, mostly with clasping base, broadly linear, acuminate, *parallel-veined*, 1° to 2° long, fringed with remote bristles. Flowers white, inconspicuous, with ovate-lanceolate, entire, *cuspidate bractlets*, in ovoid-globose, peduncled heads 7" to 10" long, subtended by *involucrate bracts*, similar to the bractlets, and *shorter than the heads*. June to Sept.

2. E. Virginianum, Lam. A tall, slender perennial or biennial (?), with hollow stem, 3° to 4° high, branching above, found in marshes or on the margins of ponds and streams near the coast from N.J. to Fla. west to Tex. *Leaves reticulate-veined*; upper ones sessile, clasping, linear, 2' to 8' long, spiny-toothed, or lacinate; lower and radical ones linear to oblong-lanceolate, entire or denticulate, on long, hollow petioles. Flowers pale blue or white, with *tricuspidate bractlets* in subglobose heads 4" to 6" long, subtended by spiny-toothed *involucrate bracts longer than the heads*. July to Sept.

II. BUPLEURUM, L. Smooth, annual or perennial herbs or shrubby plants, with simple, entire leaves and yellowish flowers

1. *C. speciosissimus*, DC. A tropical, American plant, with creeping, climbing, spreading, or sometimes erect, 3 to 5-winged or -angled stems, 2° to 6° long, 1' to 2' in diameter. The serrated wings bear fascicles of 5 to 8 stiff, slender spines, seated in white, woolly tufts. Flowers 4' to 8' wide, with white stamens and crimson or scarlet petals of various shades, dazzlingly lustrous in sunshine and lasting several days when cut and placed in water. July to Aug.

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Leaves palmately compound. Umbellets capitate	SANICULA	III
Leaves ternately or pinnately compound, decompound or dissected. (a)		
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a. Fruit with prickly secondary ribs. Leaves dissected	DAUCUS	IV
a. Fruit with no secondary ribs. (b)		
b. All the ribs bristly. Fruit slender, club-shaped. Flowers white	OSMORRHIZA	V
b. All the ribs winged. Fruit terete. Flowers yellow	THASPIUM	VI
b. Only lateral ribs winged. Fruit flattened dorsally. (c)		
b. None of the ribs winged or bristly. (d)		
c. Flowers yellow	PASTINACA	VIII
c. Flowers white; outer ones larger and irregular	HERACLEUM	IX
c. Flowers white or greenish; all alike	ANGELICA	X
d. Flowers yellow	ZIZIA	VII
d. Flowers white or whitish. (e)		
e. Nearly stemless herbs, with ternately decompound leaves	ERIGENIA	XI
e. Stout marsh herbs. Leaflets lanceolate, serrate	CICUTA	XII
e. Tall herbs, with spotted stems and no oil tubes	CONIUM	XIII
e. Cultivated herbs, with ultimate leaf segments linear	CARUM	XIV

I. ERYNGIUM, TOURN. ERYNGO. Smooth herbs, usually perennial, with coriaceous, spiny, more or less sheathing leaves, and small, white or blue, sessile, bracted flowers in dense, oblong or roundish heads; the lower bracts usually much larger, and forming an involucre to the head. Calyx teeth conspicuous, rigid, persistent. Styles long, slender. Stylopodium wanting. Fruit ovoid, scaly, or tuberculate, without ribs, usually with 3 dorsal oil tubes and 2 next the commissure.

1. E. yuccæfolium, Mx. (E. AQUATICUM, L.) RATTLESNAKE MASTER. BUTTON SNAKEROOT. A smooth, glaucous perennial, with stout, striate, simple, or branched stem, 2° to 6° high, found in wet or dry soils from the pine barrens of N.J. to Minn. south to Fla. and Tex. *Leaves* rigid, mostly with clasping base, broadly linear, acuminate, *parallel-veined*, 1° to 2° long, fringed with remote bristles. Flowers white, inconspicuous, with ovate-lanceolate, entire, *cuspidate bractlets*, in ovoid-globose, peduncled heads 7'' to 10'' long, subtended by *involucrate bracts*, similar to the bractlets, and *shorter than the heads*. June to Sept.

2. E. Virginianum, LAM. A tall, slender perennial or biennial (?), with hollow stem, 3° to 4° high, branching above, found in marshes or on the margins of ponds and streams near the coast from N.J. to Fla. west to Tex. *Leaves reticulate-veined*; upper ones sessile, clasping, linear, 2' to 8' long, spiny-toothed, or laciniate; lower and radical ones linear to oblong-lanceolate, entire or denticulate, on long, hollow petioles. Flowers pale blue or white, with *tricuspidate bractlets* in subglobose heads 4'' to 6'' long, subtended by spiny-toothed *involucrate bracts longer than the heads*. July to Sept.

II. BUPLEURUM, L. Smooth, annual or perennial herbs or shrubby plants, with simple, entire leaves and yellowish flowers

1. *C. speciosissimus*, DC. A tropical, American plant, with creeping, climbing, spreading, or sometimes erect, 3 to 5-winged or -angled stems, 2° to 6° long, 1' to 2' in diameter. The serrated wings bear fascicles of 5 to 8 stiff, slender spines, seated in white, woolly tufts. Flowers 4' to 8' wide, with white stamens and crimson or scarlet petals of various shades, dazzlingly lustrous in sunshine and lasting several days when cut and placed in water. July to Aug.

2. *C. grandiflorus*, DC. COMMON NIGHT-BLOOMING CEREUS. A tropical American plant, with terete, slightly ribbed stem, about 1' in diameter, and long, flexuous, rooting and climbing branches. Spines short, fascicled in tufts of white bristles. Flowers lateral and terminal, very fragrant, 6' to 9' wide, opening after nightfall and closing finally before daybreak. Calyx tube clothed with long bristles. Sepals yellow within, slender, spreading. Petals pure white, broad, ascending, often cup-like around the long, yellow stamens. June to Aug.

ORDER 47. UMBELLIFERÆ — PARSLEY FAMILY

Herbs, with usually hollow and striate stems, alternate, mostly compound leaves, the petioles often sheathing, and small flowers generally in umbels, rarely in heads. Calyx tube adnate to the ovary, the limb with 5 teeth, often obsolete or inconspicuous. Petals 5, usually with an incurved tip, inserted with the 5 alternate stamens in the epigynous disk. Styles 2, often with a thickened, cushion-like base called the stylopodium. Ovary inferior, 2-celled. Fruit dry, consisting of 2 cohering akenes, called mericarps, which separate when ripe along their inner face, called the commissure, and hang supported at the top by the slender, simple, or forked axis between them, called the carpophore. Each carpel is nearly always furnished with 5 longitudinal, primary ribs, and sometimes 4 secondary ones between them, often with tubular receptacles, called vittæ, or oil tubes, and containing an aromatic oil, just beneath the surface between the primary ribs and sometimes along the commissure. These show best in slices across the fruit. Seeds solitary, suspended. Umbels mostly compound, the secondary ones being called umbellets, while the whorls of bracts which often subtend the general and secondary umbels are called respectively involucre and involucl. A large family, embracing innocent, aromatic, and poisonous plants. The flowers are so much alike in all, that the genera are determinable only by the fruit, and, in most cases, are entirely too difficult

for beginners. A few only, accordingly, are here given of the most common and most easy.

Key to Genera

Leaves simple, narrow. Flowers in heads	ERYNGIUM	I
Leaves simple, ovate and perfoliate	BUPLEURUM	II
Leaves palmately compound. Umbels capitate	SANICULA	III
Leaves ternately or pinnately compound, decomposed or dissected. (a)		
a. Fruit with prickly secondary ribs. Leaves dissected	DAUCUS	IV
a. Fruit with no secondary ribs. (b)		
b. All the ribs bristly. Fruit slender, club-shaped. Flowers white	OSMORRHIZA	V
b. All the ribs winged. Fruit terete. Flowers yellow	THASPIUM	VI
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b. None of the ribs winged or bristly. (d)		
c. Flowers yellow	PASTINACA	VIII
c. Flowers white; outer ones larger and irregular	HERACLEUM	IX
c. Flowers white or greenish; all alike	ANGELICA	X
d. Flowers yellow	ZIZIA	VII
d. Flowers white or whitish. (e)		
e. Nearly stemless herbs, with ternately decomposed leaves	ERIGENIA	XI
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c. Flowers white or greenish; all alike	ANGELICA	X
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Style single or partly divided. Fruit a capsule, berry, or drupe, 2 to 10-seeded, very rarely 1-seeded.

A large, mostly tropical family, furnishing, among other useful products: coffee, the seeds of *Coffea Arabica*; quinine, from several species of *Cinchona*, the Peruvian Bark trees; ipecacuanha, from *Cephaelis Ipecacuanha*; madder, from *Bibba tinctorum*; and other dyes from several species of *Galium*.

Key to Genera

a. Leaves in whorls of 4 to 8, without stipules. Herbs	GALIUM	I
a. Leaves opposite or in whorls of 8, with stipules. (b)		
b. Herbs. Flowers in pairs	MITCHELLA	II
b. Herbs. Flowers separate. Carpels 3	HOUSTONIA	III
b. Shrubs. Flowers 4-parted, in globular heads. . . .	CEPHALANTHUS	IV
b. Small trees. Flowers 5-parted, in cymes	PINCKNEYA	V
b. Exotic shrubs. Flowers 5-parted, in clusters	BOUARDIA	VI
b. Exotic shrubs. Flowers 5-parted, solitary	GARDENIA	VII

I. GALIUM, L. BEDSTRAW. CLEAVERS. Annual or perennial herbs, with slender, square stems and branches, whorled leaves without stipules, and mostly white flowers in axillary or terminal cymes or panicles. Calyx limb obsolete. Corolla rotate, 4-parted, rarely 3-parted. Stamens 4 or 3, short. Ovary 2-celled, 2-ovuled; styles 2; stigmas capitate. Fruit globular, twin, dry or fleshy, usually separating when ripe into 2 1-seeded, indehiscent carpels. Leaves in whorls of 4, 6, or 8, rarely 5. The roots of many species yield a red or purple dye.

Flowers yellow. Leaves in 8's or 6's, narrowly linear. Fruit dry, smooth	No. 1
Flowers purplish. Leaves in 4's, 8-ribbed. Fruit dry, uncinat-hispid	Nos. 2 to 4
Flowers white. Leaves in 4's, 8-ribbed. Fruit dry, uncinat-hispid	No. 5
Flowers greenish. Leaves in 4's, 5's, or 6's, 1-ribbed. Fruit dry, uncinat-hispid	No. 6
Flowers white. Leaves in 8's, 1-ribbed. Fruit dry, uncinat-hispid	No. 7
Flowers white. Leaves in 4's, 5's, or 6's, 1-ribbed, small. Fruit dry, smooth	Nos. 8, 9
Flowers white. Leaves in 4's. Fruit a berry. Southern	Nos. 10, 11

1. G. verum, L. YELLOW BEDSTRAW. LADY'S B. A European perennial, with a slender, erect, smooth stem, 1° to 2° high, from long, fibrous roots, with short, leafy, unequal branches, naturalized in open grounds and waste places in eastern New Eng., N.Y., and N.J. Leaves in 8's, sometimes in 6's, narrowly linear, rough-edged, 6" to 12" long, soon deflexed. Flowers many, small, yellow, in dense panicles. Fruit dry, usually smooth. The roots dye red, and in England the flowers are used to curdle milk, whence called also *Curdwort*, *Cheeserennet*, etc. May to Sept.

2. G. pilosum, AIT. HAIRY BEDSTRAW. An ascending, branched, hairy perennial, 1° to 2° high, found in dry copses and sandy soils from Vt., Mass., and R.I. to Kan. south to Fla. and Tex. Leaves in 4's, oval or oval-ovate, 9" to 12" long, lateral nerves obscure, punctate, with pellucid dots and hairy on both sides. Flowers purplish, pediceled, in cymes on 2 to 3-forked, axillary, and terminal peduncles. Fruit dry, densely hispid, with hooked hairs. Var. *puncticulosum*, Torr. and Gray, nearly or entirely glabrous, with smaller, ciliate leaves, is found from southern N.J. to Fla. and Tex. June to Aug.

3. *G. circæzans*, Mx. **WILD LICORICE.** An erect or ascending, smooth or downy perennial, 1° to 2° high, branching toward the top, common in rich, dry woods from Me. to Minn., Fla., and Tex. Leaves in 4's, *oval to ovate-lanceolate, mostly obtuse, 3-nerved, 12" to 18" long, ciliate on margins and veins. Flowers greenish, with acute corolla lobes, hairy outside, sessile or nearly so, scattered along the branches of the usually once-forked peduncles, the branches diverging widely with the mature fruit, which is hispid, with hooked hairs, as in *Circæa*.* Common name due to the taste of the root and leaves. May to July.

4. *G. lanceolatum*, Torr. (G. TORREYI, BIGEL.) **TORREY'S WILD LICORICE.** A smooth or nearly smooth perennial, of dry woods from Me. to Minn. south to N.J. and Pa., very similar to the preceding, but *with ovate or ovate-lanceolate, acuminate leaves 2' or more long, and the lobes of the yellowish or purplish corolla acuminate and smooth outside.* June to Aug.

5. *G. boreale*, L. **NORTHERN BEDSTRAW.** A smooth, erect perennial, with leafy, usually simple stem, 1° to 2° high, found in rocky or shady places or along streams from Me. to Minn. south to N.J. and Pa.; also in Europe and Asia. Leaves in 4's, linear-lanceolate, rather acute, 3-nerved, 12" to 20" long. *Flowers small, numerous, in a dense, terminal, thyrselike panicle, the bright white petals with incurved points.* Fruit bristly when young, becoming smooth. May to Aug.

6. *G. triflorum*, Mx. **SWEET-SCENTED BEDSTRAW.** A common, very widely dispersed perennial, with weak, diffuse, reclining or prostrate, somewhat branched, smooth, shining stems, 2° to 3° long, roughened on the angles, found in rich woodlands throughout the north temperate regions of both hemispheres. Leaves usually in 6's, elliptic-lanceolate, cuspidate, 1-nerved, 1' to 2' long. *Flowers greenish-white, small, pediceled, on slender, axillary and terminal, 3-flowered peduncles.* Fruit hispid, with hooked hairs. *Very fragrant in drying.* June to Aug.

7. *G. Aparine*, L. **CLEAVERS. GOOSE GRASS.** A weak, reclining annual, *with retrorsely prickly stems, 2° to 3° long, by which it cleaves to and clambers over neighboring plants, common in wet thickets and shaded grounds throughout our area as well as in the Old World.* Leaves in 8's, 7's, or 6's, oblanceolate to linear, cuspidate, 1-nerved, 1' to 3' long, with rough margin and midrib. *Flowers small, white, 1 to 3, on axillary peduncles. Fruit densely covered with hooked prickles, by which it cleaves to passing animals or men. The young stems and leaves are greedily eaten by geese.* May to Sept.

8. *G. asprillum*, Mx. **ROUGH CLEAVERS OR BEDSTRAW.** A weak, much-branched perennial, *retrorsely prickly, 3° to 5° long, leaning on bushes or sometimes erect, common in thickets and low, moist grounds from Me. to Minn. south to N.C. and Mo.* Leaves in 6's or 5's, or on the branches rarely in 4's, oval-lanceolate, cuspidate, 1-nerved, 5" to 8" long, *with rough, almost prickly margin and midrib.* Flowers small, white, on twice to thrice-forked peduncles. *Fruit minute, smooth.* June to Aug.

9. *G. trifidum*, L. **SMALL CLEAVERS OR BEDSTRAW.** A very slender, weak, perennial, 5' to 10' long, much branched, rough on the angles, with retrorse prickles, found in wet grounds and sphagnum swamps throughout our area. Leaves in 4's, 5's, or 6's, linear to oblanceolate, 1-nerved, 3" to 8" long, with rough margin and midrib. *Flowers small, white, with stamens and lobes of corolla mostly 3. Peduncles 1 to 7-flowered.* Fruit smooth. A very variable species. Var. *pusillum*, GRAY, the smallest form, has leaves 3" to 4" long and 1-flowered peduncles. July, Aug.

10. *G. hispidulum*, Mx. **COARSE BEDSTRAW.** A much-branched perennial, with spreading, *somewhat hispid stems, 1° to 2° long, growing in dry or sandy soil near the coast from southern N.J. to Fla. and La.* Leaves in 4's, 1-nerved, lance-ovate, acute, mucronate, 3" to 6" long, thickish, rigid.

Flowers greenish-white, 1 to 3, on axillary peduncles. Fruit a bluish-black or purple, pubescent, twin berry. May to Sept.

11. *G. uniflorum*, Mx. A perennial, with several slender, decumbent or erect, *smooth*, mostly simple stems, 1° high, growing in rich, dry soils from S.C. to Fla. west to Tex. Leaves in 4's, linear, acute, 1' long, rough-edged, punctate beneath. Flowers white, mostly solitary, on axillary peduncles. Fruit a dark blue, *smooth* berry. June, July.

II. *MITCHELLA*, L. Creeping herbs, with opposite leaves, dimorphous flowers in pairs and their ovaries united. Calyx usually 4-toothed. Corolla funnel-shaped, 4-lobed, hairy within. Stamens 4, exserted with the style included, or included with the style exserted. Stigmas 4, linear. Ovary 4-celled, 4-ovuled. Fruit a double berry crowned with the calyx limbs of the two flowers and usually containing 8 seed-like, bony nutlets. Besides the species here given, one in Japan and one in Ecuador are also recognized.

1. *M. repens*, L. PARTRIDGE BERRY. TWIN BERRY. A small, smooth, trailing evergreen, common throughout our area, with round-ovate, coriaceous, dark green, shining, short-petioled leaves 3'' to 10'' long, minute stipules, fragrant, white flowers, often tinged with red and scarlet, edible but insipid berries remaining through the winter. It is fond of moist, shady places, forming large patches around the bases of trees, especially evergreens. June, July.

III. *HOUSTONIA*, L. *HOUSTONIA*. Small, usually tufted herbs, with opposite leaves, short, entire, connecting stipules, and blue, purple, or white, usually dimorphous flowers in cymes, or solitary and pedunculate. Calyx lobes or teeth 4, persistent, in fruit distant. Corolla salverform or funnelform, with 4 spreading lobes valvate in bud. Stamens 4. Style 1. Stigmas 2. Anthers in some individuals all exserted with stigmas included, or all included with stigmas exserted. Ovary 2-celled. Fruit a top-shaped, globose, or 2-lobed pod, the upper half usually free. Seeds few, 4 to 20 in each cell.

- a. Corolla salverform. Peduncles 1-flowered Nos. 1 to 3
- a. Corolla funnelform. Peduncles several to many-flowered. (b)
- b. Leaves lance-ovate, 3 to 5-ribbed No. 4
- b. Leaves lance-linear to linear, 1-ribbed Nos. 5 to 7

1. *H. cærulea*, L. BLUETS. INNOCENCE. COMMON *HOUSTONIA*. A delicate, little perennial, growing in tufts, with slender, erect, simple or dichotomous stems, 3' to 6' high, from thread-like rootstocks, common in moist soil from New Eng. to Mich. south to Ga. and Ala. Radical and lower leaves ovate-spatulate, petiolate, 5'' long, upper ones lanceolate, sessile, much smaller. *Flowers dimorphous*, solitary, on filiform, terminal, or axillary peduncles. Corolla salver-shaped, light blue, pale lilac, or nearly white, with a yellow center, 4'' to 6'' wide. Pod somewhat 2-lobed, compressed, about 2'' wide, its free upper half exceeded by the calyx

lobes. Called also *Quaker Ladies*, and often forming large patches of color in meadows and by roadsides. April to July.

2. *H. serpyllifolia*. THYME-LEAVED BLUETS or HOUSTONIA. A tufted perennial, found in the mts. of Va., W. Va., N.C., and Tenn., similar to the preceding, but with its filiform stems prostrate, 4' to 12' long, creeping and rooting, its leaves roundish-ovate, truncate or subcordate at base, petiolate, 2'' to 4'' long. Flowers as in No. 1, but the corolla deep blue. Pod larger, its free half equaling the calyx lobes. May to July.

3. *H. minor*, Mx. (*H. patens*, Ell.) SMALL BLUETS or HOUSTONIA. A smooth or nearly smooth annual, of dry or sandy soils from southern Va. to Fla., Ark., and Tex., 1' to 6' high, with ascending stem, and spreading, divergent peduncles. Leaves spatulate to ovate, 5'' to 6'' long, narrowed into a petiole, or the upper ones narrower, shorter, and sessile. Flowers as in No. 1, but smaller, 3'' to 4'' wide, violet-blue or purplish, without the yellow center. March, April.

4. *H. purpurea*, L. LARGE HOUSTONIA. A stout, smooth, or somewhat pubescent, erect perennial, 8' to 16' high, in woodlands and open places, especially in the mts. from Md. to Ga. west to Ky. and Ark. Leaves ovate-lanceolate, 3 to 5-veined, obtuse or acute, 6'' to 2' long, with margins often ciliate, mostly sessile. Flowers in terminal, 3 to 7-flowered, often clustered cymes. Corolla funnelform, white tinged with purple, 3'' to 4'' long, the tube much longer than the lobes. Pod globose, compressed, slightly 2-lobed, its upper half free and much exceeded by the lance-linear calyx lobes. May to July.

5. *H. ciliolata*, Torr. FRINGED HOUSTONIA. An erect or ascending, tufted perennial, 4' to 6' high, found on rocky banks from the Great Lakes and Minn. south to Pa., W. Va., Ky., and Ark. Leaves oblong or oblanceolate, radical ones rosulate, hirsute-ciliate, 6'' to 10'' long. Flowers in corymbed cymes. Corolla funnelform, pale purple or lilac, 3'' long, with tubes 3 times as long as the lobes. Pods globose, scarcely flattened or lobed, its free half much shorter than the calyx lobes. Varies imperceptibly into the next species. May to Aug.

6. *H. longifolia*, Gaertn. LONG-LEAVED HOUSTONIA. A smooth, erect, usually tufted perennial, 6' to 12' high, of dry, open, rocky or gravelly ground, from Me. to Minn. south to Ga. and Mo. Very similar to the preceding, but with its oval or oblong, radical leaves less rosulate and not ciliate, and its stem leaves linear or lance-linear, 6'' to 15'' long. Flowers and fruit nearly as in No. 5. June, July.

7. *H. tenuifolia*, Nutt. SLENDER-LEAVED HOUSTONIA. A very slender, erect, smooth perennial, 6' to 12' high, with very slender branches and peduncles, found in dry soils from southeastern Ohio to Va., N.C., and Tenn., with its radical and lowest stem leaves oval or ovate, petiolate, 4'' to 6'' long, but its upper leaves very narrow or filiform, 6'' to 15'' long. Flowers in loose corymbs or cymes. May to July.

8. *H. angustifolia*, Mx. NARROW-LEAVED HOUSTONIA. A stiff, smooth, erect, tufted perennial, 1' to 2' high, from a hard or woody root, found in dry, open places, prairies, and bottoms from Ill. to Kan. south to Tenn., Fla., and Tex. Leaves narrowly linear, 6'' to 18'' long, with many smaller ones clustered in the axils or on short, axillary branches. Flowers short-pedicelled, in dense, terminal, cymose clusters. Corolla white or purplish, funnelform, hairy inside, about 2'' long; lobes shorter than the tube. Pod obovoid, free only at its summit and little exceeded by the calyx lobes. May to July.

IV. *CEPHALÁNTHUS*, L. Shrubs, with opposite or whorled leaves, short, intervening stipules, and white or yellowish, 4-merous flowers, in dense, spherical, peduncled heads. Calyx

inversely pyramidal, adherent; limb 4-toothed. Corolla tubular-funnelform, limb 4-toothed, imbricate in bud. Stamens 4, included. Ovary 2 to 4-celled, 2 to 4-ovuled; style filiform, long-exserted; stigma capitate. Fruit dry, hard, inversely pyramidal, finally splitting upward into 2 to 4 1-seeded nutlets.

1. *C. occidentalis*, L. **BUTTON BUSH. HONEY BALLS.** A smooth or pubescent shrub, 4° to 10° high, common in swampy ground and along streams throughout our area. Leaves opposite or whorled in 3's, petioled, ovate or ovate-oblong, acuminate, 3' to 5' long, entire, glossy above, smooth or slightly pubescent beneath. Flowers fragrant, cream-white, sessile in heads about 1' in diameter, on 1 to 3 terminal peduncles 1' to 3' long. July, Aug.

V. PINCKNEYA, Mx. Shrubs or trees, with opposite leaves, deciduous, linear stipules, and flowers in terminal, compound cymes. Calyx tube campanulate; limb of 5 lanceolate, deciduous lobes, or *one of them in the outer flowers often transformed into a large, colored leaf.* Corolla tubular, with 5 linear-oblong, revolute lobes. Stamens 5, exserted. Ovary 2-celled; style 1, exserted; stigma obtuse. Fruit a 2-valved, papery capsule, with many, winged seeds. Besides the species below, a Colombian one, *P. ionántha*, is now recognized.

1. *P. pubens*, Mx. **FEVER TREE. GEORGIA BARK.** A handsome tree, 15° to 25° high, with straight, slender trunk and pubescent branches, common along marshy banks of streams and swamps in pine barrens from S.C. to Fla. Leaves oval or ovate, acute, 4' to 5' long, entire, tapering into a margined, pubescent petiole, smooth above, hoary-pubescent beneath. Flowers greenish, mottled with purple, 1' long, with pubescent corolla, calyx and pedicel in clusters 4' to 5' wide, *specially peculiar for their 5 or more transformed calyx lobes similar to the leaves in shape but smaller and rose-colored.* Properties of the bark similar to those of Peruvian bark. May, June.

VI. BOUVÁRDIA, SALISB. Ornamental, evergreen shrubs or perennial herbs, mostly from Mexico, with opposite or whorled, entire, mostly sessile leaves, small, interposed stipules, and showy, long-tubular flowers in terminal cymes. Calyx tube subglobose; limb of 4 linear, awl-shaped lobes, sometimes with minute, intervening teeth. Corolla with 4-parted, spreading limb. Stamens 4; filaments partly adherent to corolla tube; anthers linear, included. Ovary globose, 2-celled; style 1; stigma of 2 flat, exserted lobes. Fruit a membranous, 2-celled pod. Seeds many, winged.

1. *B. triphýlla*, SALISB. A small, downy shrub, 2° to 3° high, from Mexico, with lanceolate or lance-ovate leaves in whorls of 3, or opposite on the triangular, hairy branchlets, *smooth above, hairy beneath, and pubescent, scarlet flowers* 1' long, in terminal, corymbed cymes. A winter

bloomer in conservatories. The original species of the genus, cultivated for more than a century and now found in many varieties.

2. *B. leiántha*, BENTH. A shrub, 2° to 3° high, from Mexico, similar to the preceding, but more bushy and vigorous, with leaves *hairy above, and smooth, scarlet flowers*.

3. *B. fláva*, DECNE. A shrub from Mexico, 1° to 2° high, with *opposite, ovate-lanceolate, ciliate leaves, setaceous stipules, and 3 to 5-flowered racemes of very long, drooping, bright yellow flowers*, on slender, downy pedicels.

4. *B. jasminiflora*, HORT. A compact, dwarf shrub from South America, with opposite, elliptic, acuminate leaves, and *fragrant, white flowers in compound cymes*. Winter-blooming, extensively cultivated.

VII. GARDÈNIA, L. Trees and shrubs, of tropical Asia and Africa, with opposite, rarely whorled leaves, and white or yellowish, axillary or terminal, usually solitary, generally fragrant flowers. Calyx tube ovate; limb various. Corolla more or less funnel-shaped, with tube much longer than the calyx, and limb of 5 to 9 somewhat twisted segments. Anthers 5 to 9, linear, sessile in the throat of the corolla and slightly exserted. Style 1. Fruit berry-like, many-seeded.

1. *G. jasminoides*, ELLIS. (*G. FLÓRIDA*, L.) CAPE JASMINE. An erect, tender shrub from China, 2° to 6° high, with smooth, shining, elliptic leaves, acute at both ends, and very fragrant, solitary, sessile, almost terminal, white, wax-like flowers. Corolla salver-shaped, with 5 to 9-lobed limb. Fruit orange-colored, 5 to 6-angled, with tapering base. Hardy in our area as far north as Va., blooming from May to Sept. The double-flowered forms, known as *G. florida*, *G. radicans*, and *G. Fortunei*, are merely varieties of this species, which received its misnomer, Cape Jasmine, from its having been first introduced into England from the Cape of Good Hope, where it was merely an exotic.

ORDER 52. VALERIANACEÆ — VALERIAN FAMILY

Herbs, usually strong-scented and aromatic, especially their roots, with opposite, exstipulate leaves, and usually small flowers in terminal cymes, panicles, or heads. Calyx adherent, the limb membranous, obsolete, or resembling a pappus. Corolla tubular or funnelform, 4 to 5-lobed, sometimes spurred or gibbous at the base. Stamens distinct, inserted in the corolla tube, alternate with and usually fewer than its lobes. Ovary inferior, 1-ovuled, with 1 perfect cell and 2 abortive ones. Fruit akene-like, dry, indehiscent, with a single suspended seed without albumen.

Key to Genera

Fruit 1-celled, with pappus-like calyx lobes	VALERIANA	I
Fruit 3 or 2-celled, with calyx lobes tooth-like or obsolete	VALERIANELLA	II

I. VALERIANA, L. Perennial, usually tall herbs, with strong-scented roots, simple or pinnately divided leaves, and white or reddish flowers, in close, terminal, clustered cymes. *Calyx lobes circinate in flower, unrolled in fruit into 5 to 15 feathery lobes. Corolla with short tube, gibbous but not spurred at base, and 5 nearly equal, spreading lobes. Stamens 3. Fruit 1-celled, 1-seeded, the minute, empty ones having disappeared.*

1. V. officinalis, L. COMMON GARDEN VALERIAN. ST. GEORGE'S HERB. An erect, Old World, somewhat pubescent perennial, 2° to 4° high, with fibrous roots and sulcate stem, escaped from cultivation in N.Y., N.J., Pa., and southward. *Leaves all thin, reticulate-veined, pinnate; leaflets 11 to 21, lance-linear or lanceolate, acute, more or less dentate. Flowers very fragrant, pink, lavender, or whitish, in close, corymbed cymes. Corolla about 2" long. The roots, the source of the valerian of the shops, have a warm, aromatic, slightly bitter taste, and when dry a peculiar, fetid odor, very agreeable and intoxicating to cats; whence an old name, Cats' Valerian. June to Aug.*

2. V. Phu. LINN. A smooth, erect, garden perennial, about 2° high, with terete stem, from Caucasus. Radical leaves simple, undivided, oblong or elliptic; those of the stem pinnate, with 5 to 7 oblong, entire leaflets. Flowers white, in a panicle corymb. Aug.

3. V. edulis, NUTT. TOBACCO ROOT. EDIBLE VALERIAN. An erect perennial, 2° to 4° high, with a smooth, simple stem, from a deep, yellowish, carrot-like root, found in wet, open ground from Ohio to Wis. and westward. *Leaves thick, parallel-veined; radical ones linear, spatulate or oblanceolate, entire, 3' to 12' long; stem ones few, sessile, pinnately parted into 3 to 7 linear-lanceolate, acute, entire segments. Flowers yellowish-white, more or less dioecious, in a dense panicle, greatly expanded in fruit. Fruit ovate, crowned with 10 to 12 feathery bristles. The fleshy root is cooked and eaten by the Indians. May to Aug.*

II. VALERIANELLA, TOURN. Small, hardy, dichotomously branched annuals, with entire, rosulate, radicle leaves, and those of the stem entire, toothed, or rarely incisely pinnatifid. Flowers whitish, bluish, or pink, in flattish or globular clusters of dense, terminal cymes. *Calyx limb merely toothed or obsolete. Corolla tube short, funnelform; limb 5-lobed. Stamens 3. Fruit 3-celled, 1-seeded; 2 of the cells empty, and often confluent. The species are distinguished mainly by the fruit.*

1. V. olitoria, POLL. CORN SALAD. LAMB LETTUCE. FETTICUS. A succulent, Old World, garden annual, 6' to 12' high, somewhat pubescent, branching and forking from the base, naturalized in waste places from N.Y., N.J., and Pa. to Va. and La. Radical leaves spatulate, obtuse, entire, 1' to 2' long; upper stem ones oblong-lanceolate, usually dentate. Flowers bluish, about 1" long, in capitate cymes. *Fruit orbicular, glabrous, flattened next the fertile cell, which is larger than the two empty ones, and has a corky mass on its outer side. April, July.*

2. *V. radiata*, DUF. A pubescent, sometimes glabrous annual, 6' to 12' high, of low grounds from N.Y. to Minn. and Mo. south to Fla. and Tex. Leaves nearly as in No. 1. Flowers white, about 1" long, in dense cymes. Fruit ovoid, somewhat 4-angled, minutely pubescent or glabrous; empty cells as thick as the beaked, fertile one, and separated by a broad, shallow groove. May to July.

ORDER 53. DIPSACÆ — TEASEL FAMILY

Old World herbs, with opposite or whorled, exstipulate leaves, and flowers in dense heads, surrounded by an involucre, as in the *Compositæ*. Calyx adherent, with pappus-like limb. Corolla tubular or funnelform; limb 4 to 5-lobed. Stamens 4, rarely 2, alternate with corolla lobes, and distinct. Ovary inferior, 1-celled, 1-ovuled; style 1, simple. Fruit dry, indehiscent, with a single, suspended, albuminous seed.

Key to Genera

Flower bracts rigid, prickly	DIPSACUS I
Flower bracts a short scale or soft bristle	SCABIOSA II

I. *DIPSACUS*, L. TEASEL. Tall, coarse, hairy, or prickly biennials, with opposite, usually connate leaves, and oblong or globular, peduncled, involucrate heads of flowers, each flower in the axil of a long, prickly scale or bract. Calyx adherent, enveloped in a 4-sided, 4-leaved involucre. Corolla slightly irregular. Other features as in the family.

1. *D. sylvestris*, MILL. WILD TEASEL. A stout, thistle-like plant, 3° to 6° high, naturalized in waste places and along roadsides from Me. to Mich. south to Va. and Ind. Stem, branches, peduncles, and midveins of leaves prickly; otherwise nearly or entirely smooth. Leaves lanceolate, sinuate or jagged, sessile, or upper ones connate-perfoliate, 6' to 10' long. Flowers lilac, 4" to 6" long, in ovoid or cylindrical heads, with linear involucrate bracts as long as the head, and curved upward. Flower bracts ovate, tipped with a straight, sharp point. Probably the original of No. 2. July to Sept.

2. *D. fullonum*, L. FULLER'S TEASEL. A plant very similar to the preceding, but with paler flowers, the involucrate bracts shorter than the head and spreading or reflexed, and the flower bracts tipped with a hooked point, the last feature specially adapting it for teasing or raising the nap on woolen goods. The plant is cultivated for this purpose in Europe, and within a small area in central N.Y., and is sometimes found wild near woolen mills in the Eastern and Middle States. Probably a cultivated variety of No. 1, as it is found wild only as an escape. July.

II. *SCABIOSA*, L. SCABIOUS OR SCABISH. Annual or perennial herbs, with entire, toothed, lobed, or dissected leaves, and

blue, purple, rose, yellow, or white flowers in globular or ovoid-conic, peduncled, involucrate heads. Involucral bracts in 1 or 2 series, foliaceous. Flower bracts small, narrow, or none. Calyx limb bristly. Involucel nearly cylindrical, with grooves in its cup. Corolla limb often oblique or bilabiate; outer corollas often enlarged. Stamens 4, rarely 2.

1. *S. atropurpurea*, L. SWEET S. MOURNING BRIDE. A branching annual, 1° to 2° high, common in gardens, with obovate or lanceolate-ovate, lyrate, or coarsely toothed radical leaves, and those of the stem pinnately parted, with oblong, toothed, or cut lobes. Flowers dark purple, varying to crimson, rose, or white, in long-peduncled heads, which become ovate or oblong in fruit. July to Oct.

ORDER 54. COMPÓSITÆ — ASTER FAMILY

Herbs, rarely shrubs, sometimes trees in tropical regions, with alternate or opposite, exstipulate, simple, but often much divided leaves, and perfect, pistillate, or neutral, sometimes monœcious or diœcious *flowers on a common receptacle, in dense heads, surrounded by an involucre of few to many bracts, called scales, in one or more series*, the compound flowers of the old botanists. Calyx tube coherent with the 1-celled ovary; the limb, called a *pappus*, either wanting, rim-like, or divided into bristles, awns, scales, teeth, etc. Corolla tubular, ligulate or bilabiate. In the first case of 5, rarely 4, lobes with a marginal vein. Stamens 5, rarely 4, inserted on the corolla tube, and alternate with its lobes; *the anthers united into a tube (syngenesious)*. Style single, 2-cleft at its summit, in fertile flowers. *Fruit an akene, often crowned with a pappus*. The *receptacle* may be *chaffy*, i.e. with bracts, sometimes called *pales*, or collectively *chaff*, rising from its surface and subtending the individual flowers (*florets*); or *naked*, i.e. without *chaff*. It may also be *smooth* in its surface, or *alveolate*, i.e. pitted or honeycombed. Flowers (*florets*), with ligulate or strap-shaped corollas, are called *rays*, *ray flowers*, or *ray florets*, and when present make the head *radiate*. When tubular flowers are also present, as in the sunflower and aster, they occupy the *disk* or central portion of the head, and are called *disk flowers*; when

alone, as in the ironweed and boneset, they make the head *discoid*. When ray flowers alone are present, as in the dandelion, the head is called *ligulate-flowered*. When the flowers of a head are all of one kind, *i.e.* all perfect, all pistillate, or all staminate, it is *homogamous*; when they are not so, it is *heterogamous*. When the pistillate and staminate flowers are in different heads on the same plant, the *plant* is called *heterocephalous*, a term sometimes, for the sake of brevity, applied to the *heads* or *flowers*, when strictly the plant is intended. The general inflorescence is centrifugal; that of the heads, centripetal; *i.e.* the *central* and *terminal heads* and the *outer flowers of each head* develop first. The largest order among Flowering Plants (*Phanerogams*), is probably, according to latest estimates, one tenth of the whole, and embracing 10,000 to 12,000 known species in about 770 genera. The genera are grouped in 3 series, *Tubulifloræ*, *Ligulifloræ*, and *Labiatifloræ*. The first and second alone are here represented.

Artificial Key to the Genera

A. TUBULIFLORÆ

Heads discoid, *i.e.* consisting of tubular flowers only.

1. *Receptacle naked, i.e.* without chaff or bristles among the flowers. (3)
1. *Receptacle chaffy, i.e.* with chaff among the flowers. (5)
1. *Receptacle bristly* or alveolate (honeycombed). (g)
2. Pappus consisting of many capillary bristles. (8)
2. Pappus none, or a short, toothless margin. (f)
3. Leaves alternate. (4)
3. Leaves opposite. (Heads homogamous.) (b)
4. Heads homogamous. Flowers all perfect. (a)
4. Heads heterogamous. Flowers not all perfect. (e)
5. Flowers whitish or greenish. (c)
5. Flowers yellow. (d)

Heads radiate, *i.e.* the outer flowers ligulate.

Receptacle naked. (6)

Receptacle chaffy. (10)

6. Pappus of 5 to 12 scales. (h)
6. Pappus none or of a few short awns. (i)
6. Pappus of many capillary bristles. (7)
7. Rays cyanic (of the blue type), in a single row. (j)
7. Rays cyanic (of the blue type), in several rows. (l)
7. Rays yellow, in about 1 row. (8)
8. Pappus double in both disk and ray. (k)
8. Pappus simple, bristles all alike. (9)
9. Involucral scales imbricated, the outer shorter. (n)
9. Involucral scales equal, not imbricated. (m)
10. Disk and ray both fertile, the latter pistillate. (11)
10. Disk sterile, rays fertile. (p)
10. Disk fertile, rays sterile. (12)

11. Rays yellow. (n)		
11. Rays cyanic (of the blue type). (o)		
12. Akenes obcompressed, often beaked. (r)		
12. Compressed laterally or not at all. (s)		
a. Involucral scales imbricated. Flowers purple. Pappus double	VERNONIA	I
a. Involucral scales imbricated. Flowers purple. Pappus simple, plumous	LIATRIS	II
a. Involucral scales imbricated. Flowers purple. Pappus simple, not plumous	TRILISA	III
a. Involucral scales imbricated. Flowers whitish, pinkish, or purplish	EUPATORIUM	IV
a. Involucral scales in one row. Flowers white or whitish	CACALIA	XLII
a. Involucral scales in one row. Flowers reddish or orange	EMILIA	XLIII
a. Involucral scales in one row. Flowers yellow	SENECIO	XLIV
b. Involucral scales 8 to 20. Erect plants	EUPATORIUM	IV
b. Involucral scales 4 or 5. Climbing plants	MIKANIA	V
c. Monœcious, but not heterocephalous	IVA	XVII
c. Heterocephalous. Leaves opposite	AMBROSIA	XVIII
c. Heterocephalous. Leaves alternate	XANTHIUM	XIX
d. Pappus of 2 retrorsely hispid awns	BIDENS	XXIX
d. Pappus of 2 erectly hispid awns	COREOPSIS	XXVIII
e. Scales herbaceous	ERECTHITES	XLI
e. Scales scarious, persistent, often colored. Heads dioecious	ANTENNARIA	XL
e. Scales scarious, persistent, often colored. Heads heterogamous	GNAPHALIUM	XXXIX
f. Leaves opposite. Flowers dioecious, obscure	AMBROSIA	XVIII
f. Leaves alternate. Flowers yellow	TANACETUM	XXXVII
f. Leaves alternate. Flowers whitish	ARTEMISIA	XXXVIII
g. Pappus none, or consisting of scales	CENTAUREA	XLVII
g. Pappus of many plumous bristles	CNICUS	XLVIII
g. Pappus of many rough bristles	ARCTIUM	XLIX
h. Leaves alternate. Rays fertile	HELENIUM	XXXII
h. Leaves alternate. Rays sterile	GAILLARDIA	XXXI
i. Leaves opposite. Involucre single. Scales united	TAGETES	XLV
i. Lvs. altern. Pappus none. Rays fertile. Disk sterile	CALENDULA	XLVI
i. Lvs. altern. Pappus none. Fls. all fertile. Scales equal	BELLIS	IX
i. Leaves alternate. Pappus none. Flowers all fertile. Scales unequal	CHRYSANthemum	XXXVI
j. Rays 4 to 6. Invol. oblong, imbricated. Akenes very silky	SERICOCARPUS	VI
j. Rays 5 to 75. Involucre imbricated	ASTER	VII
j. Rays 40 to 200. Invol. scarcely imbricated. Scales nearly equal	ERIGERON	VIII
k. Pappus double in both disk and ray	CHRYSOPSIS	XII
l. Heads large, about 20-rayed. Pappus in 1 row	INULA	XIII
l. Heads very small, 1 to 15-rayed. Pappus in 1 row, shorter than the akene	BRACHYCHÆTA	XI
l. Hds. very small, 1 to 15-rayed. Pappus irregly. 2-rowed, white	SOLIDAGO	X
m. Heads corymb. Leaves alternate	SENECIO	XLIV
n. Scales (the 4 outer) united into a cup	TETRAGONOTHECA	XXII
n. Scales distinct. Akenes 4-angled. Pappus none	HELIOPSIS	XXI
n. Scales distinct. Akenes flat. Pappus of 2 awns	VERBESINA	XXVI
o. Leaves alternate. Pappus none. Akenes terete	ANTHEMIS	XXXIV
o. Leaves alternate. Pappus none. Akenes obcompressed	ACHILLEA	XXXV
o. Leaves opposite. Pappus of fringed scales	GALINSOGA	XXXIII
o. Lvs. opp. Pappus of the disk 1 to 2-awned, of the ray none	ZINNIA	XX
p. Leaves opposite. Rays yellow. Pappus none	POLYMNIA	XIV
p. Leaves opp. Rays yellow. Pappus a 2 to 8-toothed crown	SILPHIUM	XV
p. Leaves alternate. Rays and disk yellow. Akenes winged	SILPHIUM	XV
p. Leaves alternate. Rays whitish, very short, only 5	PARTHENIUM	XVI
r. Akenes with erectly hispid awns, or awnless. Never beaked	COREOPSIS	XXVIII
r. Akenes with retrorsely hispid awns. Flowers yellow	BIDENS	XXIX
r. Akenes usually distinctly beaked. Flowers rose, crimson, or purple	COSMOS	XXX

a. Rays white, spreading. Pappus none	ANTHEMIS	XXXIV
a. Rays purple, pendent. Pales sharp, elongated	ECHINACRA	XXIII
a. Rays yellow. Pappus none. Akenes quadrangular	RUDBECKIA	XXIV
a. Rays yellow. Pappus of 2 awns. Akenes wingless	HELIANTHUS	XXV
a. Rays yellow. Pappus of 2 awns. Akenes broadly winged	ACTINOMERIS	XXVII

B. LIGULIFLORÆ

1. Pappus consisting of little scales. Flowers blue	CICHORIUM	L
1. Pappus double, of scales and bristles. Flowers yellow	KRIGIA	LI
1. Pappus of feathery bristles	LEONTODON	LII
1. Pappus of capillary bristles. (2)		
2. Akenes terete or angular, not flattened. (3)		
2. Akenes flattened more or less. (4)		
3. Akenes not beaked. Flowers yellow or orange	HIERACIUM	LIII
3. Akenes not beaked. Flowers whitish	NABALUS	LIV
3. Akenes beaked. Pappus white	TARAXACUM	LV
3. Akenes beaked. Pappus reddish	PYRRHOPAPPUS	LVI
4. Akenes beaked or narrowed at the top	LACTUCA	LVII
4. Akenes not beaked or narrowed at the top	SONCHUS	LVIII

I. VERNONIA, SCHREB. IRONWEED. In our species perennial herbs, with leafy stems, alternate, acuminate or acute, pinnately-veined leaves, and corymbed or panicled, terminal heads of mostly purple flowers. Involucre oblong, cylindric, bell-shaped, or hemispherical, with scales imbricated in several series. Receptacle naked, flat. Flowers all tubular, perfect, regular, 5-cleft. Pappus double; the outer, chaffy; the inner, capillary. Akenes 8 to 10-ribbed, truncate.

- a. Scales of the involucre with awl-shaped or filiform tips. (b)
- a. Scales of the involucre with tips acute, obtuse or truncate. (c)
 - b. Involucres 3" to 5" wide. Scales shorter than the heads No. 1
 - b. Involucres 9" to 12" wide. Scales as long as the heads No. 2
- c. Scales closely appressed. Heads many, crowded. Leaves thick No. 3
- c. Scales closely appressed. Heads fewer, not crowded. Leaves thin No. 4
- c. Scales closely appressed. Heads few. Leaves thin, lower ones oval No. 5
- c. Scales closely appressed. Heads rather large. Plant woolly No. 6

1. V. noveboracensis, L. COMMON OR NEW YORK IRONWEED. A conspicuous plant, 3° to 6° high, common in moist grounds from Mass. to Minn. south to Ga. and Mo. Leaves crowded, rough, lanceolate to lance-oblong, serrulate, 3' to 6' long. Heads in open, flat-topped cymes; scales ovate or ovate-lanceolate, purplish, ending in a slender, thread-like tip. Flowers deep purple. July to Sept.

2. V. arkansana, DC. (V. CRINITA, Raf.) GREAT IRONWEED. A stout plant, 8° to 10° high, on prairies and along streams from Mo. and Kan. to Tex., with linear-lanceolate, finely denticulate leaves 4' to 12' long. Involucres hemispheric, 9" to 12" wide, 50 to 75-flowered. Scales green or reddish, awl-shaped, with spreading, thread-like tips as long as the head. Aug. to Oct.

3. V. fasciculata, Mx. WESTERN IRONWEED. A smooth or smoothish plant, 2° to 6° high, common in low or moist ground from Ohio to Minn. and S. Dak. south to Ky. and Tex. Leaves thick, firm, narrowly lanceolate, long-acuminate, serrulate, 3' to 6' long. Heads 20 to 30-flowered, short-peduncled or sessile, usually many and crowded. Involucres ovoid-bell-shaped, 2" to 3" wide. Scales oval or ovate, ciliate, appressed. July to Sept.

4. *V. altissima*, NUTT. (*V. gigantea*, BRITTON.) TALL IRONWEED. A smooth plant, 5° to 10° high, found in low grounds or moist soils from western Pa. to Ill. south to Fla. and La. Leaves thin, veiny, *dark green above and beneath*, lanceolate, acuminate, finely serrate, 4' to 12' long. Flowers and heads much as in No. 3, but fewer and less crowded. July to Sept.

5. *V. glauca*, BRITTON. BROAD-LEAVED IRONWEED. A smooth or finely puberulent, slender plant, 2° to 5° high, found in woods from Pa. to Ohio south to Fla. and La. Leaves *thin, pale beneath*, lanceolate to elliptic, *the lower ones broadly oval*, sharply serrate, acute or acuminate, 4' to 7' long. Heads few, on loosely branched, slender peduncles, 10 to 20-flowered. Involucre bell-shaped, 2'' to 3'' wide. Aug. to Sept.

6. *V. Drummondii*, SHUTTLEWORTH. DRUMMOND'S IRONWEED. A coarse, stout, woolly plant, 3° to 7° high, common on prairies from Ill. to Kan. south to Ala. and Tex. Leaves lanceolate, acute or short-acuminate, sharply serrate, 4' to 12' long, *rough above, densely pubescent beneath*. Heads 15 to 20-flowered, short-peduncled, usually in close corymbs. Involucres hemispherical, 2'' to 6'' wide. Scales purplish. Aug. to Oct.

II. *LIATRIS*, SCHREB. BLAZING STAR. BUTTON SNAKE-ROOT. Erect, perennial herbs, with simple or sparingly branched stem, from a roundish tuber, alternate, entire, narrow leaves, and rose-purple flowers in spiked or racemed heads. Flowers all perfect, tubular, in few, many-flowered heads. Involucral scales imbricated in several rows. Receptacle naked. Corolla regular, its tube and 5 lobes slender. Akenes slender, 10-ribbed, tapering to the base. Pappus of plumose or barbellate, capillary bristles.

- a. Involucral scales prolonged into petaloid tips No. 1
- a. Involucral scales not prolonged into petaloid tips. (b)
- b. Pappus clearly plumose. Lobes of the 15 to 60 corollas hairy within Nos. 2, 3
- b. Pappus clearly plumose. Lobes of the 8 to 5 corollas smooth within Nos. 4, 5
- b. Pappus only barbellate, smooth to the naked eye. (c)
- c. Heads many (20 to 40)-flowered, rounded, 6'' to 12'' wide No. 6
- c. Heads few (7 to 15)-flowered, oblong Nos. 7, 8
- c. Heads few (8 to 6)-flowered, in a regular spike or raceme Nos. 9, 10
- c. Heads few (8 to 6)-flowered, in a 1-sided raceme No. 11

1. *L. elegans*, WILLD. HANDSOME BLAZING STAR. A plant, with simple, hairy stem, 2° to 3° high, found in dry, barren soils from Va. to Fla. and Tex. Leaves smooth, punctate; radical and lower ones lanceolate; upper ones linear, becoming bract-like in the slender spike or raceme 6' to 20' long. Heads 3 to 6-flowered, narrowly bell-shaped, 5'' to 7'' long. *Involucral scales hairy; inner ones prolonged into spreading, petaloid, purple, or rarely white tips, longer and showier than the purple flowers.* Pappus distinctly plumose. Aug. to Oct.

2. *L. squarrosa*, WILLD. COMMON BLAZING STAR. A smooth or hairy plant, with stout stem, 6' to 30' high, found in dry soils from N.J. and Pa. to Minn. and Neb. south to Fla. and Tex. Leaves narrowly linear, 3' to 6' long. Heads cylindric or top-shaped, 4'' to 8'' wide, usually few, 5 to 20, or sometimes solitary, sessile or nearly so. *Flowers 15 to 60 in a head, bright purple, corolla lobes hairy within. Scales in 5 to 7 rows, lanceolate, with acuminate, spreading, or squarrous tips.* Pappus distinctly plumose. June to Sept.

3. *L. cylindracea*, Mx. A slender or stout, usually smooth plant, 6' to 18' high, in dry, open places and prairies from western N.Y. to Minn.

south to Ill. and Mo. Leaves rigid, narrowly linear, 3' to 7' long. Heads sessile or stalked, *cylindric-top-shaped*, 6'' to 12'' long, 15 to 20-flowered. Scales in 5 or 6 rows, short, rounded or obtuse, appressed, ciliate, abruptly acuminate. Flowers, corolla lobes, and pappus as in No. 2. July to Sept.

4. *L. tenuifolia*, Nutt. A very elegant plant, with smooth, slender, simple stem, 2° to 4° high, and slender, linear or filiform leaves, found in pine barrens from N.C. to Fla. Lowest leaves crowded, very long, resembling those of the long-leaf pine, diminishing gradually to bristle-like bracts above. Heads about 5-flowered, crowded on slender pedicels in a raceme 10' or more long. Corollas purple, lobes smooth within. Scales oblong, obtuse, mucronulate. Pappus distinctly plumose. Aug. to Oct.

5. *L. punctata*, Hook. DOTTED BLAZING STAR. A stout plant, 10' to 30' high, from a stout, branching, or roundish rootstock, found in dry soils from Minn. to Mo. and Tex. and westward. Leaves rigid, linear, 2' to 6' long, diminishing upward, and with the involucreal scales very punctate. Heads 7'' to 10'' long, 4 to 6-flowered, in dense, wand-like, usually leafy spikes. Flowers purple. Involucres narrowly bell-shaped. Scales oblong, cuspidate, ciliate, in 4 or 5 rows. Pappus distinctly plumose. Aug. to Oct.

6. *L. scariosa*, Willd. LARGE BLAZING STAR. GAY FEATHER. A handsome plant, with a stout, rough, pubescent or hoary stem, 2° to 5° high, found in dry woods and fields throughout our area. Leaves below, lanceolate or oblanceolate, tapering to a petiole, 3' to 9' long; above, narrowly lanceolate or linear. Heads large, hemispheric, 6'' to 12'' wide, 20 to 40-flowered, on stout peduncles, or sometimes sessile, in a loose spike or raceme. Flowers bluish-purple. Scales in 5 or 6 rows, spatulate or obovate, obtuse, appressed, with dry, scarious, often purplish margins or tips. Pappus barbellate, rough to the naked eye. Aug., Sept.

7. *L. spicata*, Willd. A smooth or slightly hairy plant, with stout, very leafy stem, 2° to 5° high, common in moist grounds from Mass. to Minn. south to Fla., Ky., Ark., and La. Leaves linear-lanceolate, 3 to 5-nerved, the lower very long, gradually diminishing upward to the linear-subulate bracts of the spike. Heads small, short-oblong, 2'' to 4'' wide, 5 to 15-flowered, sessile, in a dense spike 5' to 15' long. Flowers bluish-purple, sometimes white. Scales and pappus nearly as in No. 6. The species varies considerably in the relative width of the leaves, the length of the spikes, and the size of the heads. Aug.

8. *L. graminifolia*, Willd. A smooth or somewhat hairy plant, with slender, simple stem, 2° to 3° high, and many linear, grass-like leaves, found in wet or dry soils, especially in pine barrens, from N.J. to Fla., Ga., and Ala. Leaves 1-nerved. Heads 6'' long, 5 to 15-flowered, usually in racemes, often in spikes, sometimes paniced below. Involucres 2'' to 4'' wide, with acute base. Scales 12 to 18, appressed, punctate, obovate-spatulate. Flowers purple. Pappus barbellate, rough to the naked eye. Akenes hairy. Sept., Oct.

9. *L. gracilis*, Pursh. A grayish plant, with simple, slender, woolly, somewhat hoary stem, 1° to 3° high, found in dry pine barrens of Ga., Fla., and Ala. Leaves smooth, linear, 1-nerved, short, the lower ones lanceolate or oblanceolate, obtuse, petioled, the upper ones linear, spreading or appressed. Heads small, 3 to 6-flowered, sessile, or on slender, hairy stalks, in a long raceme, or rarely paniced. Scales oblong, obtuse, or mucronate. Pedicels vary greatly in length and direction. Sept.

10. *L. pycnostachya*, Mx. PRAIRIE BLAZING STAR. A very leafy plant, with simple, stout, hairy, or smooth stem, 2° to 5° high, found in dry soils and on prairies from Ind. and Ky. to Minn. and Neb. south to Ark. and Tex. Leaves crowded; lower ones linear-lanceolate, veined, 8' to 20' long; upper ones narrowly linear, short, ascending. Heads 4'' to 6'' long, 3 to 6-flowered, sessile, crowded in very dense, thick spikes 5' to 20' long. Involucres oblong or cylindric, scales oblong or lanceolate, with acute,

spreading or recurved, scarious or colored tips. Pappus barbellate, not plumose. Aug., Sept.

11. *L. secunda*, ELL. (*L. PAUCIFLORA*, PH.) A plant with slender, pubescent, ascending, recurved stem, 1° to 3° high, growing on dry, sandy ridges in S.C. and Ga. Leaves smooth, linear, short; lowest ones linear-lanceolate, 2' to 4' long. Heads 4 to 5-flowered, in a long, slender recurved, 1-sided (*secund*) raceme, the heads all turned upward. Scales lance-oblong, acute. Pappus barbellate. Sept.

III. *TRILISA*, CASS. Erect, perennial herbs, with fibrous roots, alternate, simple, lanceolate or broader leaves, and small, discoid heads of 5 to 10 perfect, purple flowers in terminal corymbs or thyrse-like panicles. Scales of involucre nearly equal, in 2 or 3 rows. Receptacle naked, flat. Pappus of rigid but not plumose bristles. Only 2 species.

1. *T. odoratissima*, CASS. VANILLA PLANT. HOUND'S TONGUE. A smooth, rather stout plant, 2° to 3° high, found in low pine barrens from Va. to Fla. and La. Leaves thick, oblong, ovate, or oval, or lower ones obovate-spatulate, obtuse, entire, or sometimes dentate, 4' to 10' long. Heads about 3" long, in a large, corymbed panicle. Flowers bright purple. The leaves when bruised exhale a vanilla-like odor and are said to be mixed with tobacco leaves to flavor them. Sept., Oct.

2. *T. paniculata*, WILLD. A plant similar to the preceding and of about the same range, but with viscid-pubescent stem, entire leaves, the heads in a dense, oblong thyrseoid panicle, and flowers pale purple or white. Sept., Oct.

IV. *EUPATORIUM*, L. Erect, perennial, often resinous-dotted herbs, with opposite, whorled, or alternate leaves, and in our species corymbed or paniced, discoid heads of white, blue, or purplish, never yellow, flowers. Receptacle flat, conical or convex, naked. Involucre oblong or bell-shaped. Scales more than 4, imbricated in 1 or more rows. Corolla 5-toothed. Style much exserted, deeply cleft. Pappus simple, capillary, roughish. Akenes 5-angled.

a. Leaves pinnately divided, mostly alternate	Nos. 1, 2
a. Leaves undivided, opposite or whorled. (b)	
b. Leaves whorled	Nos. 3, 4
b. Leaves opposite, connate-perfoliate	No. 5
b. Leaves opposite, sessile	Nos. 6, 7
b. Leaves opposite, petioled. Flowers white	Nos. 8, 9, 10
b. Leaves opposite, petioled. Flowers blue	No. 11

1. *E. fœniculaceum*, WILLD. DOG FENNEL. A very branching, fennel-scented weed, 3° to 10° high, common in fields from Md. to Fla. Leaves alternate, pinnately dissected; the lower petioled, compoundly pinnatifid into linear, filiform segments, the uppermost sessile, becoming simple. Heads 3 to 5-flowered, very small, very numerous, in paniced racemes. Scales 8 to 10, mucronate. Flowers greenish-white. Sept., Oct.

2. *E. coronopifolium*, WILLD. A more or less viscid plant, 2° to 4° high, common in dry, thin, or sandy soils from N.C. to Fla., similar to the preceding, but with the lower leaves opposite; the segments lance-linear; heads 5-flowered; scales 10, cuspidate, with scarious margins. Sept., Oct.

3. *E. purpureum*, L. JOE PYE WEED. A stout herb, 3° to 10° high, common in moist soil throughout our area, with green or purple, solid or hollow, terete, striate or fluted stem, and thin, petioled, oval, ovate or ovate-lanceolate, acuminate, serrate leaves, 4' to 12' long, in whorls of 3 to 6. Flowers pink or purplish, in 5 to 10-flowered heads, massed in large, terminal, hemispherical or pyramidal, compound corymbs. Involucres cylindrical, scales oblong, obtuse, pink, imbricated in 4 or 5 rows. The species varies much, especially in the size, markings, and solidity of the stem, giving occasion for at least one distinct species, *E. fistulosum*, Barratt, a very tall form with hollow stem, hence called *Trumpet Weed*, and possibly to the following, *E. maculatum*. Aug., Sept.

4. *E. maculatum*, L. SPOTTED JOE PYE WEED. A plant 4° to 6° high, in low grounds from N.Y. to Minn. south to Ky. and Kan., similar to the preceding, but with the striate stem usually purple-spotted, the leaves thick, triple-veined, ovate, in whorls of 3 to 5, the inflorescence flattish, rather dense, and the involucral scales pubescent. Aug., Sept.

5. *E. perfoliatum*, L. THOROUGHWORT. BONESET. A plant common in low and wet grounds throughout our area, with a stout, hairy stem, 2° to 4° high, and divaricate, connate-perfoliate, lanceolate, acuminate, serrate-dentate, very veiny, wrinkled leaves 4' to 7' long. The veiny, wrinkled leaves, downy beneath, are so united at their bases as to form a single blade 8' to 14' long, tapering from the center to each end. Heads 10 to 16-flowered, in large, very compound corymbs. Scales linear-lanceolate. Flowers dull white. Leaves very bitter, a well-known domestic tonic. Aug.

6. *E. sessilifolium*, L. UPLAND BONESET. A slender, erect, smooth plant, 2° to 6° high, branching at the top, in dry and rocky upland woods from Mass. to Ill. and southward along the mts. to Ga. and Ala. Leaves opposite, or the lowest rarely in 3's, closely sessile or amplexicaul, veiny, smooth, ovate-lanceolate, sharply serrate, thin, 3' to 6' long, tapering regularly from near the rounded base to the long, sharp point. Heads 5-flowered, in a pubescent, compound corymb. Flowers white. Involucres bell-shaped. Scales oval or oblong, obtuse, imbricated, in 2 or 3 rows. Aug. to Oct.

7. *E. rotundifolium*, L. WILD HOARHOUND. A compact, bushy, roughish, downy-pubescent plant, 2° to 3° high, in dry soil from southern N.Y. and N.J. to Ky. south to Fla. and Tex. Leaves opposite, sessile, roundish-ovate, acutish or obtuse, subcordate, dentate-crenate, 3-ribbed, veiny, 1' to 2' long, rough above, pubescent beneath. Heads 5-flowered, in large, dense, flattish corymbs. Involucral scales linear-lanceolate, acute, in 2 or 3 rows, very pubescent, concealing the florets. Style much exserted. Aug., Sept.

8. *E. serotinum*, Mx. LATE-FLOWERING THOROUGHWORT. A bushy-branched herb, with finely pubescent stem, 4° to 6° high, in low grounds from Md. to Minn. and eastern Kan. south to Fla. and Tex. Leaves all slender-petioled, 3-ribbed, lanceolate, acute or acuminate, sharply serrate, 3' to 6' long; the upper ones nearly entire, scattered, the lower opposite. Heads 12 to 15-flowered, in compound corymbs. Involucres bell-shaped. Scales pubescent, imbricated, in 2 or 3 rows. Flowers white. Sept. to Nov.

9. *E. ageratoides*, L. WHITE SNAKEROOT. WHITE SANICLE. A smooth, branching plant, 2° to 4° high, common in rich and rocky woods from Me. to Neb. south to Ga. and La. Leaves opposite, thin, on long, slender petioles, 3-ribbed, ovate, acuminate, rounded or subcordate at base, sharply toothed, 3' to 5' long. Heads many, in a compound corymb, 10 to 20-flowered. Scales linear, acute, equal, in 1 row. Flowers pure white. Called also *Indian Sanicle* and *Deerwort Boneset*. Aug., Sept.

10. *E. aromaticum*, L. SMALL WHITE SNAKEROOT. A plant similar to the preceding, in low woods from Mass. to Fla. and La., but somewhat downy and later in blooming, with nearly simple stem, 1° to 2° high. The

leaves also are thickish, on short petioles, narrowly ovate, acute, bluntly toothed, 2' to 4' long, and the involucre more spreading than in No. 9, with usually obtuse scales. Otherwise as in No. 9. Aug., Sept.

11. *E. cælestinum*, L. (*CONOCLINIUM CÆLESTINUM*, DC.) MIST FLOWER. A slightly pubescent, branched herb, 1° to 3° high, found in rich, moist soil from N.J. to Mich. and Kan. south to Fla. and Tex. Leaves opposite, petioled, triangular-ovate, acute or obtuse, subcordate or truncate, crenate-serrate, 1' to 3' long. Heads many-flowered, in corymbed cymes. Receptacle conical, involucre widely bell-shaped. Scales linear, in 1 row. Flowers sky-blue, turning purple or reddish in fading. Sept.

V. *MIKANIA*, WILLD. Twining perennials, or in the tropics a few erect shrubs, with opposite, oblong, ovate, cordate or lobed leaves, and many small, cylindrical flower heads in racemes, corymbs, or panicles. Heads discoid, 4-flowered. Involucre of 4 scales. Otherwise, the same as *Eupatorium*.

1. *M. scandens*, WILLD. CLIMBING HEMPWEED OR BONESET. A handsome, smooth or smoothish twiner, 5° to 15° long, climbing over bushes in wet thickets, along streams and in swamps from Mass. to Ind. south to the West Indies and South America. Leaves triangular-ovate, acuminate, deeply cordate or hastate, repand-toothed, 2' to 4' long, on slender petioles half as long. Heads of white or pink flowers in peduncled, axillary corymbs. July to Sept.

VI. *SERICOCARPUS*, NEES. WHITE-TOPPED ASTER. Erect, perennial herbs, with alternate, sessile, entire or serrate leaves, and radiate heads of flowers clustered in terminal, flat corymbs. Ray flowers 4 to 6, white, pistillate. Disk flowers 6 to 15, perfect, pale yellow. Involucre oblong. Scales imbricated, in several rows, coriaceous, whitish, appressed, with short, spreading, green tips. Receptacle alveolate. Akenes obconic, silky. Pappus simple, of many capillary bristles.

1. *S. conyzoides*, NEES. TOOTHED WHITE-TOPPED ASTER. A plant with simple, somewhat pubescent, slightly 5-angled stem, 1° to 2° high, corymbously branched at the top, common in dry woods and thickets from Me. to Ohio south to Fla. and Ala. Leaves thin, ciliate, oval-lanceolate, or the lower spatulate, somewhat serrate, 2' to 4' long; the upper nearly entire. Heads loosely or densely clustered, 4" to 6" long. Involucre bell-shaped. Scales oval or oblong, the outer ones with reflexed, green tips. Pappus rusty. July to Sept.

2. *S. solidagineus*, NEES. NARROW-LEAVED WHITE-TOPPED ASTER. A smooth and slender-stemmed plant, 1° to 2° high, of nearly the same range as No. 1, with thick, entire, linear or linear-spatulate leaves 1' to 2' long. Heads 3" to 4" long. Involucre oblong-bell-shaped. Pappus white. June to Sept.

VII. *ÁSTER*, L. ASTER. STARWORT. Perennial, rarely annual herbs, with alternate leaves, and corymbed, paniced, or rarely racemed or solitary, radiate heads of flowers blooming in late summer and autumn. Disk flowers perfect, yellow, usually changing to brown, red, or purple; ray flowers pistil-

late, in 1 row, violet, blue, purple, pink or white, never yellow. Involucre hemispheric, bell-shaped, or top-shaped. Scales imbricated, in several rows, usually with green tips, often spreading. Receptacle naked, flat, alveolate. Pappus simple, rarely double, capillary, rough. Akenes usually flattened and ribbed.

As remarked in Gray's "Flora of North America" (Vol. I, Part II, page 172), this "is far the most difficult of our genera, both for the settlement of the names of the species and for their limitation, in respect to which little satisfaction has been attained as the result of long and repeated studies." Accordingly, the species here presented are only a few of the more easily determined, many others equally as common and as widely distributed or even more so, being omitted. For these the student is referred to the fuller floras of Wood, Gray, Britton and Brown, and John K. Small, the last issued in 1908.

- § **DIPLOPAPPUS.** Pappus double, the outer of very short, rigid bristles. Nos. 1, 2
 § **ASTER.** Pappus simple, of long capillary bristles. (a)
 a. Heads corymbd, large. Rays 6 to 15, white. Leaves cordate Nos. 3, 4
 a. Heads corymbd or few. Rays 12 to 30, blue or violet. Pappus rigid, inner bristles clavate Nos. 5, 6, 7
 a. Heads panicled or racemed, rarely few. Pappus bristles soft; all alike. (b)
 b. Scales imbricated, appressed, with scarious margins, and without green tips No. 8
 b. Scales variously imbricated, with green or leaf-like tips, or the outer ones entirely leafy. (c)
 c. Leaves petiolate. Lower ones cordate Nos. 9, 10, 11
 c. Leaves sessile, silky-canescens on both sides Nos. 12, 13
 c. Leaves sessile, not silky-canescens, with narrow base. (d)
 c. Leaves sessile, not silky-canescens, with clasping, cordate or auriculate base. (e)
 d. Heads squarrose, large. Rays violet No. 14
 d. Heads squarrose, small. Rays white No. 15
 e. Leaves very small, 1" to 8" long. Scales with spreading tips Nos. 16, 17
 e. Leaves average size, 1' to 6' long. Scales with appressed tips No. 18
 e. Leaves average size, entire. Scales loosely spreading Nos. 19, 20
 e. Leaves average size, serrate. Scales very loose No. 21

1. *A. linearifolius*, L. (*DIPLOPAPPUS*, HOOK. *IONACTIS*, GREENE.) **TOADFLAX-LEAVED ASTER.** A small, handsome plant, with simple or sub-simple, purplish stem, 6' to 20' high, found in dry woods throughout our area. Stem straight, erect. Leaves linear, 1' long, entire, 1-veined, mucronate, rigid, shining above. Heads solitary at the top of the simple stem or terminating the few simple branches. Rays 10 to 15, violet, rarely white. Involucre top-shaped. Scales in several rows, appressed, without green tips. Pappus tawny, double, none of the inner thickened. Akenes silky. Aug., Sept.

2. *A. umbellatus*, MILL. (*DIPLOPAPPUS*, HOOK.) **TALL FLAT-TOP WHITE ASTER.** A smooth plant, with straight, channeled, purplish, simple stem, 2° to 7° high, common in low, moist grounds and thickets from Me. to N. Dak. south to Ga. and Ark. Leaves lanceolate to oblong-lanceolate, entire, acuminate, narrowed at the base, 3' to 6' long, rough-margined, membranous, velvety. Heads many, 6" to 10" wide, in a large, flat, terminal, compound corymb. Rays about 12, white. Involucre bell-shaped. Scales lanceolate, obtuse, in 3 or 4 rows, without green tips. Pappus double; the outer short, stiff bristles; the inner, long, capillary, some of them thickened above. Akenes with pubescent lines. Aug., Sept.

3. *A. corymbosus*, AIT. (*A. DIVARICATUS*, L.) **WHITE WOOD ASTER.** A neat plant, 1° to 2° high, with a slender, nearly smooth, terete, ascending, zigzag stem, large, thin, heart-shaped leaves, and a few, large, white-rayed heads of flowers, common in dry, open woodlands from Me. to Minn. south to Ga. and Tenn. Leaves ovate-lanceolate, acuminate, sharply serrate, with spreading teeth, the lower cordate, on slender, wingless petioles.

Heads 9' to 12'' wide, with 6 to 9 white, rarely roseate rays, in a broad, flat, open corymb. Disk flowers yellow, soon becoming brown. Involucre obovoid-bell-shaped. Scales in several rows, appressed, barely tipped with green. Akenes slender. Pappus simple, somewhat rigid. July, Aug.

4. *A. macrophyllus*, L. LARGE-LEAVED ASTER. A plant similar to the preceding in range and in the size of the leaves and heads, but with a stout, rigid, rough, branching, angular, or furrowed stem, 2° to 3° high, thickish, rough, ovate, closely serrate, abruptly pointed leaves, often 6' to 10' long, some of them with winged petioles. Heads larger and in closer corymbs. Rays 10 to 15, white or bluish. Aug., Sept.

5. *A. spectabilis*, AIT. LOW SHOWY ASTER. A handsome plant, from a slender rootstock, with stout, erect stem, 1° to 2° high, branching corymbously above, found in dry, sandy soils from Mass. to Del. and Ky. Leaves roughish, oblong-lanceolate, or the lower spatulate-oblong, sessile, entire, the lower subserrate. Flowers in a simple corymb of 10 to 15 large, showy heads, each with 15 to 25 bright violet rays 8'' to 10'' long. Involucre hemispherical. Scales imbricated, in about 5 rows, glandular, viscid, squarrose, spreading. Sept. to Nov.

6. *A. surculosus*, Mx. CREEPING ASTER. A plant with long, filiform, creeping rootstock, sending up, like suckers (surculosus), slender stems, 10' to 15' high, simple or corymbous at the top, found in wet pine barrens and sandy soils from N.J. to Ga. and Tenn. Leaves linear-lanceolate, rigid, entire, or nearly so; the upper linear; root leaves spatulate, 4' to 6' long. Flowers in 1 to 5 heads, each about 15'' wide, with 15 to 25 violet-purple rays. Involucre and scales nearly as in No. 5, but not glandular. Sept., Oct.

7. *A. gracilis*, NUTT. SLENDER OR TUBER ASTER. A plant similar to No. 6, and of similar range and habitat, with slender stems, 12' to 18' high, from a rootstock sometimes tuberous-thickened. Lower and root leaves oval, acute, or obtuse, 2' to 3' long, toothed, narrowed into slender petioles; upper ones oblong-lanceolate to linear, acute, entire, sessile. Heads few to many, 6'' to 10'' wide, each with 9 to 12 violet rays. Involucre narrowly top-shaped, 3'' to 4'' long, smooth, not glandular, scales white, coriaceous. July to Sept.

8. *A. acuminatus*, Mx. WHORLED OR MOUNTAIN ASTER. A plant with simple, angular, zigzag stem, 1° to 3° high, branching corymbously above, found in cool, rich woods from Me. to Pa. and southward along the mts. Leaves thin, broadly oblong, acuminate, unequally and remotely dentate above the middle, narrowed and entire toward the cuneate, sessile base, 3' to 6' long, often close together above, as if whorled. Heads 12'' to 18'' wide, several or many, in a terminal, corymbous, nearly naked panicle. Rays 12 to 18, narrow, 6'' to 8'' long, white or purplish. Involucre nearly hemispheric. Scales few, lax, thin, with scarious margins, linear-subulate. Aug., Sept.

9. *A. cordifolius*, L. COMMON BLUE WOOD ASTER. A plant very common in woods and thickets from Me. to Minn. south to Ga. and Mo. Stem smoothish, much branched and bushy above, 1° to 5° high. Leaves thin, smooth or rough above, more or less pubescent on both sides, cordate, acuminate, sharply serrate; the lower and root ones ovate-cordate, 2' to 5' long, on slender petioles; the upper short-petioled or sessile. Involucre obconic; scales oblong-linear, obtuse, closely appressed, with short, green tips. Heads very many, 2'' to 3'' high, 6'' to 9'' wide, with 10 to 20 pale blue to white rays. Variable. Sept.

10. *A. sagittifolius*, WILLD. ARROW-LEAVED ASTER. A plant with stiff, straight, erect, smooth stem, 2° to 4° high, with racemose, ascending branches, common in dry soils from Me. to N. Dak. south to N.J., Ky., and Mo. Lower leaves ovate-lanceolate, acuminate, sharply serrate, cordate, or sagittate, 3' to 5' long, on slender petioles; upper ones lanceo-

late, serrate or entire, on short-winged petioles or sessile; those of the branches becoming very small, lanceolate to linear. Heads very many, 2" to 4" high, 8" to 10" wide, crowded, racemed, with 10 to 15 pale blue or whitish rays. Involucre oblong to turbinate. Scales linear-subulate, with slightly spreading, green tips. Aug., Sept.

11. *A. undulatus*, L. WAVY-LEAF ASTER. A pale, pubescent or hoary plant, with stiff, rough stem, 2° to 3° high, common in dry woods from Me. to Minn. south to Fla., Ala., and Ark. Leaves thick, rough, downy beneath, ovate or ovate-lanceolate, acute or acuminate, *undulate*, crenate-dentate or entire; lowest and root ones cordate, 2' to 5' long, on naked or winged petioles; middle ones with the winged petioles dilated at base and clasping; upper, clasping or sessile, those on the branches small, awl-shaped. Heads many, in a loose, racemose panicle, about 4" high and 8" to 10" wide, with 8 to 15 pale or bright blue rays. Involucre obovoid. Scales linear-oblong, with appressed green tips. Very variable. Aug., Sept.

12. *A. sericeus*, VENT. WESTERN SILVERY ASTER. A bushy plant, with clustered stems, 1° to 2° high, smooth below, silky-pubescent and branching above, growing on prairies and in dry, open soils from Wis. to Minn. south to Tenn., Mo., and Tex. *Leaves silvery-silky on both sides*, sessile, entire; stem ones oblong or lanceolate, 6" to 18" long, with broad base; lowest and root ones oblanceolate, narrowing into winged petioles 2' to 3' long. *Heads large, mostly solitary, terminal, on the short, leafy branches*, 15" to 20" wide, with 20 to 30 deep violet-blue rays. Scales of turbinate involucre in 3 or 4 rows, canescent. *Akenes smooth*. Pappus tawny. Aug. to Oct.

13. *A. concolor*, L. EASTERN SILVERY ASTER. A slender plant, with nearly simple stem, 1° to 3° high, found in dry, sandy soils near the coast from eastern Mass. to Fla. and La. Leaves crowded, ascending, lance-oblong, entire, sessile, obtuse or mucronate, 18" to 2' long, *silvery-silky on both sides*. Heads with 10 to 15 lilac rays 3" to 4" long, *in a long, terminal raceme, resembling Liatris*. Involucre broadly top-shaped. Scales lanceolate, appressed, silky, in 4 or 5 rows. *Akenes silky*. Pappus tawny. Aug. to Oct.

14. *A. grandiflorus*, L. LARGE-FLOWERED ASTER. A very showy plant, with slender, hispidly rough stem, 1° to 3° high, and corymbose, 1-flowered (1-headed) branches, found in dry, open places from Va. to Fla. Leaves linear-spatulate or oblong-linear, obtuse, entire, hispid, sessile, or subclasping; lower ones 2' long; upper ones and those on the branches 2" to 5" long. Heads 2' wide, terminal; rays very many, deep violet. Involucre hemispheric, squarrose. Scales in 5 to 7 rows, linear, reflexed, the outer leafy. Sept. to Nov.

15. *A. ericoides*, L. WHITE HEATH ASTER. FROST-WEED ASTER. A smooth or slightly hairy, bushy plant, 1° to 3° high, with spreading, wand-like branches, and racemed, often secund, 1-headed branchlets, common in dry, open places from Me. to Wis. south to Fla. and Ky. Lowest leaves spatulate, toothed, 1' to 2' long; stem ones linear; those on the branches and branchlets subulate, numerous. Heads many, small. Rays 15 to 25, white or pinkish. Involucre bell-shaped. Scales in 2 or 3 rows, nearly equal, with subulate, spreading, green tips. Several varieties occur. Sept. to Dec.

16. *A. squarrosus*, WALT. A singular plant among asters, of dry pine barrens from N.C. to Fla., with shrubby base, slender, rigid, paniculately branched stem, 1° to 2° high, *the branches throughout squarrose, with rigid, spreading, recurved, ovate-subulate, or triangular-cordate, amplexicaul leaves 1" to 2" long*. Radical leaves rosulate, spatulate to cuneate. Heads few, chiefly solitary, terminating the branchlets, with 15 to 25 violet rays 3" to 4" long. Involucre bell-shaped. Scales in several rows, with dark green, slightly spreading, green tips. Sept. to Nov.

17. *A. adnatus*, Nutt. A plant of dry pine barrens in Ga., Fla., and Ala., resembling the preceding in its flowers, and as singular in its leaves. Stems erect and virgately branched, 1° to 2° high, and somewhat hispid. Leaves oblong, very rough, 2" to 3" long, with the midrib adnate to the stem. Radical leaves obovate, free, 6" to 12" long. Sept. to Nov.

18. *A. lævis*, L. SMOOTH ASTER. A very smooth and handsome plant, with usually a stout, green, polished, often glaucous, simple or branched stem, 2° to 4° high, common in woodlands from Me. to Minn. south to Pa., La., and Kan. Leaves thickish, oblong, lanceolate or ovate-lanceolate, entire or serrate; the upper sessile and cordate-clasping, 1' to 4' long; lower and root ones gradually narrowed into winged petioles; those on the branches small, bract-like. Heads usually many, 1' wide, with 16 to 30 sky-blue rays turning purple. Involucre bell-shaped. Scales rigid, in several rows, appressed, with thickened, green tips. Akenes smooth. Pappus tawny. Very variable. Sept., Oct.

19. *A. patens*, Ait. LATE PURPLE ASTER. A rough, pubescent plant, with stiff, simple stem, 1° to 3° high, branching widely above, common in dry or moist grounds throughout our area. Leaves ovate-oblong to oblong-lanceolate, acute, entire, cordate, 1' to 3' long, clasping, with a broad, often auriculate base, thick, rough, especially above and along the edge; those of the branches small and bract-like. Heads 1' wide, mostly solitary, terminating the branchlets. Rays 20 to 30, 4" to 6" long, purplish-blue. Involucre broadly top-shaped. Scales in several rows, with acute, spreading, green tips. Variable. Aug. to Nov.

20. *A. Novæ-Angliæ*, L. NEW-ENGLAND ASTER. A handsome plant, with stout, hairy stem, 3° to 8° high, corymbously branched above, common in moist grounds from Me. to Minn. south to S.C., Mo., and Kan. Leaves rather thin, very many, lanceolate, entire, acute, 2' to 5' long, auriculate-clasping, pubescent. Heads many, 1' to 2' wide, clustered, terminal, with 40 to 50 violet-purple, rarely pink, red, or white, linear rays 5" to 8" long. Involucre hemispherical; scales linear, awl-shaped, nearly equal, green, loose, spreading, glandular, viscid. Akenes hairy. Pappus deeply tawny. More common in Middle and Western States than in New England. Sept., Oct.

21. *A. puniceus*, L. EARLY PURPLE ASTER. PURPLE-STEM ASTER. A handsome plant, very common in low thickets, swamps, and ditches from Me. to Minn. south to N.C. and Ohio, with a stout, hispid stem, 3° to 7° high, red or purple below and paniced above. Leaves oblong-lanceolate to lanceolate, acuminate, clasping by a wide or narrowed, auriculate base, coarsely or sharply serrate to denticulate, rough above, nearly smooth beneath, 3' to 6' long. Heads usually many, 12" to 18" wide, with 20 to 40 lilac-purple rays. Involucre hemispheric. Scales many, equal, imbricated, linear, green, loose, spreading. Varies very much. July to Oct.

VIII. *ERIGERON*, L. Herbs, with alternate or radical, entire or toothed leaves, and solitary or corymbous, radiate heads of flowers resembling those of *Aster*, but with ray florets in more than 1 row, very numerous, 40 to 200, and very narrow, and the involucreal scales narrow, nearly equal, never leaf-like nor green-tipped. Receptacle flat or convex, naked. Pappus usually simple.

Rays minute, shorter than the involucre, white.	Pappus simple	. . .	No. 1, 2
Rays long, showy, 30 to 40.	Pappus simple.	. . .	No. 3
Rays long, showy, 50 to 200.	Pappus simple. Leaves clasping	. . .	No. 4, 5, 6
Rays long, showy, 50 to 200.	Pappus double. Leaves sessile	. . .	No. 7, 8

1. *E. Canadensis*, L. HORSEWEED. BITTERWEED. A very common, annual weed, with a bristly-hairy, wand-like, erect, branching stem, 1° to 5° high, found by roadsides, in fields, and waste places, not only throughout our country but widely diffused over the world. Leaves mostly linear, entire, sessile; lower and radical ones oblanceolate or spatulate, 1' to 4' long, entire, dentate or incised. Heads small, 2'' wide, very numerous, paniced. Rays many, 40 to 50, white, inconspicuous, the ligule shorter than its tube or pappus. June to Nov.

2. *E. divaricatus*, Mx. LOW OR PURPLE HORSEWEED. A diffusely branched, decumbent, pubescent or hirsute annual, 3' to 12' high, found in sandy soils, especially along streams, from Ind. to Minn. south to Tenn., La., and Tex. Leaves linear or awl-shaped, entire, 4'' to 12'' long. Heads corymb. Otherwise as No. 1. June to Aug.

3. *E. nudicaulis*, Mx. EARLY FLEABANE. A smooth perennial, with simple, scape-like stem, 1° to 2° high, from a thick rootstock, and rosulate, radical leaves, found in low grounds, moist soils, and pine barrens from Va. to Fla. and La. Leaves oval or obovate, obtuse, 2' to 4' long, entire or slightly toothed, narrowed to a petiole; 1 or 2 sessile, bract-like ones on the stem. Heads 5 to 12, in a corymb. Rays 30 to 40, white, conspicuous. April, May.

4. *E. bellidifolius*, MUHL. ROBIN'S PLANTAIN. A hirsute or pubescent perennial, with slender, simple stem, 10' to 24' high, and offsets from its base, common in copes and on moist banks throughout our area east of the Mississippi. Radical leaves obovate or spatulate, obtuse, somewhat toothed, 1' to 3' long; stem ones distant, lance-oblong, sessile, partly clasping, entire. Heads 3 to 7, 12'' to 18'' wide, in a close, terminal corymb. Rays 50 to 60, linear-spatulate, nearly twice as long as the involucre, light bluish-purple. Pappus simple. April to June.

5. *E. Philadelphicus*, L. COMMON FLEABANE. A hairy or sometimes nearly glabrous perennial, with slender, leafy stem, 1° to 3° high, and offsets from its base, found in woods, pastures, and moist grounds throughout North America except in the extreme north. Leaves thin; lower and radical ones obovate or spatulate, obtuse, crenate-dentate, 1' to 3' long; upper ones oblong-lanceolate, mostly entire, clasping, often with a cordate or auriculate base. Heads few, 5'' to 12'' wide, corymb on long, slender peduncles. Rays 150 to 200, filiform, more than twice as long as the depressed-hemispheric involucre, rose-purple or flesh-colored. Scales linear. Pappus simple. June to Aug.

6. *E. quercifolius*, L. OAK-LEAVED FLEABANE. A plant very much like the preceding, found in low grounds from S.C. to Fla. and La. It differs chiefly in having its radical and lower leaves mostly sinuate-pinnatifid, like those of an oak (*quercifolius*), the clasping stem ones sharply serrate, the upper ones entire. It is also less hairy, has smaller and more numerous heads, and pale purple rays. March to June.

7. *E. annuus*, Pers. DAISY FLEABANE. SWEET SCABIOUS. A stout, erect, leafy-stemmed, corymbously branched annual, 2° to 4° high, pubescent, with scattered, spreading hairs, a very common weed in fields and waste places from Me. to N. Dak. south to Va., Ky., and Mo., and naturalized in Europe. Leaves thin; radical and lower ones ovate, obtuse, coarsely serrate, 2' to 6' long, tapering to a winged petiole; upper ones lanceolate, acute, sessile, sharply toothed in the middle; highest ones and those on the branches narrowing to linear, entire. Heads 5'' to 9'' wide, usually many, on short peduncles, in a large, diffuse, terminal, corymbous panicle, with 50 to 100 linear, white, or purplish-tinged rays 2'' to 4'' long. Involucre hemispheric, bristly. Pappus double; the inner of deciduous, fragile, slender bristles, often lacking in the rays; the outer, a persistent crown of minute scales. May to Nov.

8. *E. strigosus*, MUHL. DAISY FLEABANE. A common weed, in fields

throughout our area, resembling the preceding, but *with smaller, simpler stem, smaller heads, and longer rays, the stem and leaves rough, with short, appressed, stiff hairs (strigosus) or almost smooth.* Leaves lanceolate or linear-lanceolate, entire or nearly so, tapering to each end; lower ones spatulate or oblong, tapering to a slender petiole, usually toothed. Rays white or purplish, sometimes minute or wanting. Involucre glabrous. Pappus as in No. 7. June to Nov.

IX. BÉLLIS, L. Annual or perennial, leafy-stemmed or stemless herbs, with alternate or radical, entire or sinuate-toothed leaves, and solitary, radiate heads of flowers terminating the branches or scapes. Disk flowers yellow, perfect. Rays white, pink, or purple, pistillate. Involucre hemispheric or broadly campanulate; scales nearly equal, in 1 or 2 rows, herbaceous. Receptacle conical or convex, naked. Akenes obovate, flattened. Pappus none.

1. **B. integrifolia, Mx.** WESTERN DAISY. A smoothish, diffusely branched annual or biennial, 6' to 12' high, found in moist grounds from Ky. and Tenn. to Ark. and Tex. Leaves thin, *entire* (integrifolia), obtuse; radical and lower ones obovate-spatulate, narrowed to winged petioles 1' to 3' long; upper ones smaller, oblong or lanceolate, sessile. Heads 7" to 14" wide, on slender peduncles. Rays violet-purple. May to July.

2. **B. perennis, L.** ENGLISH, EUROPEAN, OR GARDEN DAISY. An Old World, stemless perennial, cultivated in gardens and escaped and somewhat naturalized in parts of New Eng., with numerous, obovate, obtuse, crenate leaves 1' to 2' long, tapering to the base and slightly hairy, all radical and rosulate, and solitary heads of flowers 6" to 12" wide, on naked scapes 3' to 5' high. Rays normally, in its wild state, *linear*, white, in a single row; disk flowers yellow; but in cultivation the forms are usually *double*, i.e. the rays have crowded out the disk florets and have undergone change in color, to pink, red, etc. This is the daisy of British literature from Chaucer to Burns. Our wild daisy (*Chrysanthemum Leucanthemum*), though native also in England, is there called by a different name. April to July.

X. SOLIDAGO, L. GOLDEN-ROD. Erect perennial herbs, rarely shrubs, with usually simple, wand-like stems, alternate, simple, entire or toothed, *never heart-shaped*, leaves, and axillary or terminal clusters, racemes or panicles of small radiate heads of flowers, with one exception (No. 2 below) yellow, both in disk and ray. Disk flowers usually all perfect. Rays pistillate, 1 to 15, in 1 row, rarely wanting. Involucre oblong. Scales imbricated in several rows, *appressed*, and with rare exceptions *without green tips*. Receptacle flat or slightly convex, narrow, usually alveolate. Pappus simple, capillary, rough. Akenes terete or angled, mostly ribbed.

- a. Involucral scales with spreading tips No. 1
- a. Involucral scales with appressed tips. (b)
 - b. Inflorescence chiefly axillary. (c)
 - b. Inflorescence terminal, in recurved second racemes. (d)
 - b. Inflorescence terminal, in flat-topped corymbs No. 2

a. Rays white or cream-colored	No. 3
c. Rays golden yellow, like the disk	No. 3, 4
d. Leaves 8-ribbed, entire or mostly so	No. 5
d. Leaves 8-ribbed, serrate	No. 6
d. Leaves not 8-ribbed, entire, smooth	No. 7
d. Leaves feather-veined, serrate, rugose	No. 8

1. *S. squarrosa*, MUHL. **STOUT RAGGED GOLDEN-ROD.** A handsome plant, with simple, stout stem, 2° to 5° high, pubescent above, found in rocky, wooded hills from Me. to Va. and Ohio. Leaves glabrous; lower oval-spatulate, 4' to 10' long, serrate, acute, tapering to a winged petiole; upper lanceolate-elliptic; highest entire, sessile. Disk flowers 15 to 25; rays 10 to 15, showy, 2'' to 3'' long. Involucral scales rigid, oblong, green, *squarrose*, with *spreading or recurved tips* (ragged for a golden-rod), rarely erect. Heads very large, in a terminal spike of short, dense, axillary clusters or racemes. Aug. to Oct.

2. *S. bicolor*, L. **WHITE GOLDEN-ROD. SILVER-ROD.** A hairy plant, with usually simple stem, 1° to 3° high, common in dry soils from Me. to Minn. south to Ga. and Mo., distinguished from all other golden-rods by its white or cream-colored rays, making its heads 2-colored (bicolor). Leaves elliptic-lanceolate, acute at each end, entire; the lower oval, obtuse, tapering to a petiole, somewhat serrate, 2' to 4' long. Heads in clusters or short racemes from the upper axils, making a narrow, terminal, interrupted spike or spike-like thyrses. Rays about 8, short, obscure. Var. *concolor*, T. and G., has yellow rays. July to Sept.

3. *S. cæsia*, L. **BLUE-STEMMED OR WREATH GOLDEN-ROD.** A plant with erect, slender, round, smooth, mostly glaucous, often bluish or purple, simple stem, 2° to 4° high, sometimes branched above, common in rich woods and thickets and along shady roadsides from Me. to Minn. south to Fla., Ill., Ky., Ark., and Tex. Leaves smooth, linear-lanceolate, acuminate, narrowed at the base, sharply serrate, 2' to 5' long, glaucous beneath. Heads small, 2'' to 3'' long, about 10-flowered, in axillary clusters or short racemes along the stem, or the upper in a short, terminal thyrses. Flowers deep rich yellow. Rays 3 to 5, longer than the involucre. Akenes pubescent. Aug. to Oct.

4. *S. latifolia*, L. (*S. flexicaulis*, L.) **BROAD-LEAVED OR ZIGZAG GOLDEN-ROD.** A plant with smooth, *flexuous or zigzag, angular* stem, 2° to 4° high, common in rich woods and on moist, shaded banks from Me. to Minn. south to Ga. and Mo. Leaves thin, broadly oval or ovate, acuminate, abruptly narrowed to a winged petiole, sharply serrate, 3' to 6' long; the uppermost sometimes lanceolate and entire. Heads in very short, axillary, racemed clusters, which are sometimes prolonged in a narrow, terminal thyrses. Flowers as in No. 3. July to Sept.

5. *S. nemoralis*, AIT. **GRAY, FIELD, OR DUSTY GOLDEN-ROD.** An ashy-gray plant, of a dusty aspect, clothed with a fine, close, soft, or roughish pubescence, with mostly simple stem, 1° to 2° high, very common in old fields, open woods (*nemoralis*), or dry soils generally throughout our area. Leaves thick, roughish, oblanceolate, obscurely 3-veined; radical and lowest ones somewhat serrate or crenate-dentate, 3' to 6' long, tapering into a petiole; upper lanceolate, mostly entire. Leaves often fasciated in the axils. Flowers very bright yellow, in heads 2'' to 3'' long, disposed usually in many dense, 1-sided, spreading or recurving racemes, forming a large, terminal panicle usually turned to one side. Sometimes the heads are in a single, terminal, recurved raceme. Disk and ray flowers each 5 to 7, the latter conspicuous. Akenes pubescent. July to Nov.

6. *S. Canadensis*, L. **COMMON GOLDEN-ROD.** A conspicuous plant, with stout, furrowed, hairy to pubescent stem, 3° to 6° high, very common, perhaps the commonest species from Me. to Fla. west to the Rockies. Leaves lanceolate, acuminate, 3-veined, serrate, rough above, pubescent beneath,

lower ones 3' to 6' long; upper smaller, often entire. Heads very small, about 2'' long, with 6 to 10 disk florets and 6 to 12 *very short rays*, in 1-sided, recurving racemes, forming usually a large, dense, 1-sided, terminal panicle. Stem and leaves vary greatly in roughness and hairiness. Aug. to Nov.

7. *S. odora*, AIT. SWEET OR ANISE-SCENTED GOLDEN-ROD. BLUE MOUNTAIN TEA. A unique species, found in dry and sandy soils from Me. and Vt. to Fla. and Ky. Stem simple, slender, smooth, terete, usually yellowish-green, 2° to 4° high. Leaves linear-lanceolate, acuminate, entire, sessile, shining, smooth on both sides, rough-edged, with a strong, yellowish midvein and no veinlets, *pellucid-dotted*, 2' to 4' long, *anise-scented when bruised*. Heads 2'' to 3'' long, in spreading second racemes 2' to 3' long, forming a small, inclined panicle. Disk and ray flowers each 3 to 4, the latter rather large. The leaves are used in the Blue Mountain regions for making tea, and by distillation yield a fragrant volatile oil. The only species of *Solidago* known to have useful or agreeable properties other than æsthetic. An occasional form is said to be nearly scentless. July to Sept.

8. *S. rugosa*, MILL. (*S. altissima*, T. AND G.) WRINKLE-LEAVED GOLDEN-ROD. An early-flowering, very variable species, with hairy, leafy, usually stout, often tall stem, 2° to 7° high, simple or much branched at the top, found in dry soils, borders of fields and copees and along roadsides throughout our area. Leaves very many, lanceolate to oval or oblong-lanceolate, acute or acuminate, 1' to 4' long, sharply serrate, rough and wrinkled (*rugosa*), sessile, or the lowest sometimes narrowing into petioles. Heads about 2'' long, with 4 to 7 disk flowers and 6 to 8 rays, in second racemes on the spreading or recurved, often leafy branches, forming usually a large, terminal, compound panicle. Aug., Sept.

9. *S. lanceolata*, L. BUSHY OR FRAGRANT GOLDEN-ROD. A plant with smooth, pubescent or hairy, angular, erect *corymbously branched stem*, 2° to 4° high, common in meadows and wet grounds from Me. to N. Dak. south to Fla. and Mo. Leaves numerous, linear-lanceolate, acuminate, 3 to 5-veined, rough-edged, slightly hispid on the veins beneath. Heads 2'' to 3'' long, sessile, in small clusters crowded in terminal, flat-topped corymb. Rays 15 to 20, minute. Disk flowers 8 to 12. Involucre ovoid-campanulate. Scales slightly glutinous. Whole plant fragrant. July to Sept.

XI. *BRACHYCHÆTA*, T. AND G. A monotypic genus, differing from *Solidago* mainly in its pappus, which is a single row of *short, scale-like bristles* (*Brachychæta*), shorter than the akene, and in its leaves, *which are rounded and the lower ones cordate*.

1. *B. cordata*, T. AND G. FALSE GOLDEN-ROD. A perennial herb, resembling a golden-rod, with erect, simple or branched stem, 2° to 4° high, found in dry woods from western Va. to Ind. south to northern Ga. and eastern Ky. Radical leaves broadly ovate, cordate or truncate, acute, sharply serrate, pinnately veined, 3' to 6' long, on slender petioles as long or longer; lower stem ones gradually smaller, ovate, on short, winged petioles; upper ones sessile, entire. Flowers golden yellow in heads 2'' to 3'' long, solitary or in sessile, racemed or spiked clusters. Disk flowers and short rays each 4 or 5. Aug., Sept.

XII. *CHRYSÓPSIS*, NUTT. GOLDEN ASTER. Mostly hairy, woolly, or silky perennial herbs, with alternate, entire, sessile, oblong, lanceolate or linear leaves, radical ones sometimes toothed, and terminal, solitary or corymbed *heads of flowers*

yellow both in disk and ray, the former perfect, the latter pistillate. Involucral scales linear, imbricated in several rows. Receptacle mostly flat, somewhat alveolate. Pappus of disk and ray florets alike, double; the outer very short, scale-like bristles; the inner numerous, rough, capillary bristles. Akenes linear to oblong or obovate, flattened, hairy.

Leaves linear or lanceolate, parallel-veined. Akenes linear Nos. 1 to 4
Leaves oblong or lanceolate, pinnately-veined. Akenes obovate Nos. 5 to 7

1. *C. graminifolia*, NUTT. GRASS-LEAVED GOLDEN ASTER. A silvery-silky plant, 1° to 3° high, with slender, erect, leafy stem, corymbously branched above, common in dry soils and pine woods from Del. to Ohio south to Fla. and Tex. Leaves soft, shining, linear, tapering to each end, 3 to 5-veined; radical ones 4' to 8' long; upper numerous, much shorter, passing to subulate bracts. Heads few or many, usually terminal and solitary, 5'' to 8'' wide. Akenes silky pubescent. Involucre campanulate. July to Oct.

2. *C. oligantha*, CHAPM. SPRING-FLOWERING GOLDEN ASTER. A plant of damp pine woods in Fla. and southeastern Ga., 1° to 2° high, similar to the preceding, but with the stem above nearly naked, the heads few (*oligantha*), 1 to 4, 7'' to 8'' wide, and flowering in spring. April, May.

3. *C. pinifolia*, ELL. PINE-LEAVED GOLDEN ASTER. A smooth plant, with slender, rigid stem, 1° to 2° high, and almost filiform branches, on sandy hills of middle Ga. Lowest leaves narrowly linear, 2 to 3-veined, 2' to 6' long; stem ones filiform. Heads 7'' to 8'' wide, terminal, solitary or corymb. Sept., Oct.

4. *C. falcata*, ELL. SCYTHE-LEAVED GOLDEN ASTER. A low, woolly, leafy plant, 4' to 10' high, in dry, sandy soil near the coast from Mass. to N.J. Leaves linear, 1' to 4' long, rigid, slightly recurved or subfalcate, spreading, obscurely 3-veined. Heads 3'' to 5'' wide, terminal on the corymb. Sept., Oct.

5. *C. Mariàna*, NUTT. A plant common in pine barrens and dry or sandy soils from southern N.Y. and N.J. to Fla. and La., with stout, simple stem, 1° to 2° high, and clothed, as also the leaves, with loose, weak, silky, deciduous hairs. Leaves oblong, lanceolate or oblanceolate, pinnately veined, 1' to 2' long. Heads usually few, 8'' to 10'' wide, on glandular peduncles, in an umbel-like corymb. Rays 15 to 20. Involucre hemispheric. Aug. to Oct.

6. *C. villosa*, NUTT. HAIRY GOLDEN ASTER. A very variable, rough-hairy, villous, hirsute or pubescent plant, with corymbously branched stem, 1° to 2° high, common on dry plains and prairies from Wis. to Ala. and westward. Leaves oblong, lanceolate or oblanceolate, 1' to 2' long, fringed near the base; the upper ones sessile; the lowest narrowed into a petiole. Heads few, 12'' to 15'' wide, terminal on the short, corymb. Rays 20 to 30. Involucre hemispheric. July to Sept.

7. *C. gossypina*, NUTT. COTTONY GOLDEN ASTER. A densely villous and hoary biennial (Chapman), 1° to 2° high, covered throughout with a cottony tomentum, found in pine barrens and dry, sandy soils from Va. to Fla. and Ala. Stem stout, branching above. Leaves oblong or spatulate, obtuse, the lowest and radical 1' to 3' long, the upper much smaller. Heads 10'' to 12'' wide, terminating the branches. Rays 20 to 30. Involucre hemispheric. Aug. to Oct.

XIII. *INULA*, L. Coarse, hardy, hairy, Old World, mostly perennial herbs, with alternate or radical, entire or serrate

leaves, and heads of yellow disk and ray flowers, the latter rarely white. Disk flowers perfect; ray pistillate. Receptacle naked. Involucre hemispheric or bell-shaped; scales imbricated, in several rows; outer ones often leafy. Pappus simple, capillary, rough. Anthers with 2 bristles at the base. Akenes 4 to 5-ribbed.

1. **I. Helénium**, L. **ELECAMPANE**. A European perennial, naturalized along roadsides and in fields from Me. to Minn. south to N.C. and Mo., with stout, tufted, simple stems, 3° to 5° high, from large, thick roots, downy and sometimes slightly branched above. Leaves large, rough above, downy beneath, broadly oblong or ovate; radical ones petioled, 1° to 2° long; cauline, smaller, sessile, somewhat clasping. Heads large, 2' to 3' wide, solitary, terminal. Rays linear, narrow, very many. Outer involucre scales ovate, leaf-like, pubescent. Akenes smooth. Roots mucilaginous, expectorant, tonic. Called also *Yellow Starwort*, *Elfdock*, etc. July, Aug.

XIV. POLÝMNIA, L. **LEAFCUP**. Coarse, heavy-scented, perennial herbs in our species, some South American shrubby or tree-like; with opposite leaves, or the uppermost alternate, and heads of yellow disk and ray flowers in paniced corymbs. Disk flowers perfect but sterile; rays pistillate, fertile, few, or rarely wanting. Receptacle flat, chaffy. Involucre of 2 rows of scales; the outer about 5, large, leaf-like, spreading; the inner smaller, about 10, *forming together a leafy cup*. Pappus none. Akenes triangular-obovoid, glabrous.

1. **P. Uvedàlia**, L. **LARGE-FLOWERED LEAFCUP**. A stout, rough, hairy herb, 4° to 8° high, in rich woods from N.Y. to Ind. and Mich. south to Fla., Mo., and Tex. Leaves broadly ovate-deltoid in outline, 3-ribbed above the abrupt contraction of the decurrent base, angulate-lobed, pubescent on both sides; lower ones petioled, often 1° or more long and wide; upper, smaller, angulate-sinuate, sessile. Heads few, 2' to 3' wide, *short-peduncled*, in terminal clusters. Rays 7 to 14, with *bright yellow, linear-oblong ligules 6'' to 9'' long, much longer than the inner scales*. Outer scales ciliate, 4'' to 10'' long. Akenes *strongly striate*. July, Aug.

2. **P. Canadénsis**, L. **SMALL-FLOWERED LEAFCUP**. A coarse, rather slender, clammy-hairy herb, 2° to 5° high, in damp, rich ravines and shaded places from Vt. to Minn. south to Pa. and Mo. and along the mts. to N.C. Leaves thin, 4' to 10' long, all petioled, deltoid-ovate, acuminate, *deeply angulate-lobed*, the lobes dentate; or the lower, deeply pinnatifid. Heads few, sessile, in terminal clusters 4'' to 6'' wide. Rays about 5; *the pale yellow ligules obovate or wedge-shaped, much shorter than the inner scales, sometimes minute or wanting*. Outer scales 2'' to 3'' long. Akenes 3-ribbed, *not striate*. Var. *radiata*, GRAY, from Ill. to Kan. and southward, has whitish ligules 3'' to 6'' long. June to Sept.

XV. SÍLPHIUM, L. **ROSINWEED**. **ROSIN PLANT**. Tall, coarse perennials, with resinous juice, opposite, whorled, or alternate leaves, and corymbed, paniced or rarely solitary

heads of yellow disk and ray flowers. Disk flowers perfect but sterile. Rays many, in 2 or 3 rows, pistillate, fertile. Involucre broadly campanulate, flattish. Scales imbricated, in several rows; outer ones leaf-like and loose at summit; innermost like the linear pales of the flat, chaffy receptacle. Akenes broad, flat, obcompressed, margined by a wing notched at the apex. Pappus none, or 2 teeth at the top of the wing.

Stems nearly leafless. Leaves pinnatifid	No. 1
Stems nearly leafless. Leaves ovate	No. 2
Stems leafy. Leaves mostly whorled in 3's and 4's	No. 3
Stems leafy. Leaves mostly alternate	No. 4
Stems leafy. Leaves opposite, connate and perfoliate	No. 5

1. *S. laciniatum*, L. COMPASS PLANT. POLAR PLANT. A rough, bristly herb, 3° to 10° high, on prairies from Ohio and Mich. to Dak. south to Ala., La., and Tex. Radical leaves 1° to 2° long, long-petioled, 1 to 2-pinnatifid, the lobes lanceolate or linear; stem ones alternate, short-petioled below, sessile above, gradually smaller and less divided. Heads 2' to 5' wide, few or many, bracted, distant, sessile or short-peduncled, along the naked summit of the stem. Rays 20 to 30, 1' to 2' long. Scales ovate, tapering in long, squarrose, stiff points. Its vertical leaves tend to turn their edges north and south, and its abundant resin produces columns of smoke in burning prairies. Called also *Pilot Weed*, *Rosinweed*, *Turpentine Weed*.

2. *S. terebinthinaceum*, L. PRAIRIE DOCK. A smooth herb, with slender, nearly naked, simple stem, 4° to 8° high, and a panicle of large heads at the top, on prairies and in dry, open woods from Ohio and Mich. to Minn. south to Ga. and La. Leaves mostly radical, thick, firm, becoming rough with age, ovate or cordate-ovate, dentate-serrate, 1° to 2° long, on long, slender petioles. Heads 1' to 3' wide, several or many, on glabrous peduncles. Rays 12 to 20. Involucre hemispheric; scales obovate. Akenes narrowly winged, 2-toothed. Var. *pinnatifidum*, GRAY, occurring with and running into the type, has more or less deeply cut or pinnatifid leaves. Called also *Prairie Burdock*, *Rosinweed*, etc. July to Sept.

3. *S. trifoliatum*, L. WHORLED ROSINWEED. An herb, with rather slender, smooth, often glaucous, simple stem, branched at the top, 4° to 7° high, found in dry woods from Pa. to Ohio south to Va. and Ala. Leaves oblong-lanceolate, acute, 3' to 7' long, entire or denticulate, short-petioled; middle ones nearly always in whorls of 3 or 4; the uppermost opposite. Heads 18'' to 30'' wide, several or many, in a loose, cymose panicle. Rays 12 to 16. Akenes oval, winged, with two sharp teeth at the top. July to Oct.

4. *S. Asteriscus*, L. ASTERISK ROSINWEED. A leafy herb, with terete, generally purple stem, 2° to 4° high, simple or branched above, usually hispid, but varying to hirsute, pubescent, or smooth, common in dry soils from Md. to Tenn. and Mo. south to Fla. and La. Leaves mostly alternate, lower ones opposite, or rarely whorled in 3's, ovate to lanceolate, acute or obtusish, toothed or entire, 2' to 5' long, sessile, or the lower ones tapering into a petiole. Heads few, squarrose; scales leafy; rays 12 to 15, 1' long. Akenes obovate or oval, 2'' to 4'' long, winged, 2-toothed. June to Aug.

5. *S. perfoliatum*, L. CUP PLANT. INDIAN CUP. A coarse herb, with stout, square, usually smooth stem, 4° to 8° high, usually branched above but sometimes simple, common in rich, moist soils and along streams

from Mich. to Minn. and Neb. south to Ga. and La., and also escaped from cultivation eastward and naturalized near N. Y. City. Leaves large, thin, rough, ovate or deltoid-ovate, coarsely toothed, the largest 6' to 14' long, opposite; the upper connate-perfoliate, entire, *united by their bases into a cup*; the lower abruptly contracted into winged petioles with connate bases. Heads 2' to 3' wide, cymosely arranged on long peduncles terminating the branches. Rays 20 to 30, 1' long. Outer scales ovate, spreading or erect. Akenes obovate, 6'' long, winged, notched. Called also *Ragged Cup*. July to Sept.

XVI. PARTHËNIUM, L. Perennial American herbs or undershrubs, with alternate leaves and corymbed or paniced heads of white, whitish, or yellowish disk and ray flowers. Disk flowers staminate, with undivided style, sterile. *Ray flowers 5, pistillate, fertile; their broad, obcordate ligules very short.* Receptacle conical, chaffy. Involucre hemispheric; scales in 2 rows, roundish, nearly equal. Akenes 5, obcompressed, margined, bearing on top the persistent corolla. Pappus 2 small awns or scales.

1. P. integrifolium, L. AMERICAN FEVERFEW. PRAIRIE DOCK. A rough-pubescent herb, with erect, stout, striate, pubescent, or glabrous stem, 2° to 4° high, in dry soils from Md. to Minn. south to Ga., Mo., and Tex. Leaves coriaceous, somewhat hispid, roughish, oblong, or ovate, crenate-dentate, or the lower cut-lobed toward the base; radical ones long-petioled, 4' to 12' long; upper ones smaller, sessile. Heads many, in a dense, 1' t, terminal corymb. Flowers white or whitish. June to Sept.

XVII. ÌVA, L. Coarse, herbaceous, or shrubby North American plants, with thick leaves, the lower opposite, and small, nodding heads of greenish-white flowers, axillary and solitary, or in spikes, racemes, or panicles. *Heads discoid, monœcious. Marginal flowers 1 to 5, pistillate, fertile, with or without a small, tubular corolla; inner, with funnellform corolla, stamens and undivided style, sterile.* Anthers scarcely united. Receptacle small, chaffy. Involucral scales few, rounded. Pappus none. Akenes obconic, glabrous.

1. I. frutescens, L. MARSH ELDER. HIGH-WATER SHRUB. A shrubby or herbaceous, nearly smooth perennial, with stem 3° to 8° high, paniculately branching above, common along salt marshes and on muddy coasts from Mass. to Fla. and Tex.; more shrubby south, more herbaceous north. Leaves fleshy, oval, or lanceolate, coarsely serrate; the lower 4' to 6' long; the upper lance-linear and linear, entire, gradually diminishing in size and width. Heads on short pedicels subtended by the bract-like upper leaves in paniculate racemes. Involucral scales 5, rounded, distinct. Fertile flowers 5; corollas tubular. Akenes 5. July to Sept.

XVIII. AMBRÒSIA, L. Coarse annual or perennial herbs, with alternate or opposite, mostly lobed or dissected leaves,

and *small heads of green, mostly monœcious flowers, the fertile and sterile in separate heads.* Fertile heads in sessile clusters of 1 to 3, in the axils of leaves or bracts at the foot of the spikes or racemes of the sterile ones. *Fertile involucre* (fruit) more or less top-shaped, *closed, resembling an akene, entire, or 4 to 8-toothed, containing a single, apetalous, pistillate flower.* *Sterile involucre* cup-shaped or saucer-shaped, *open, of 5 to 12 united scales, containing 5 to 20 barren flowers with funnellform corollas; anthers nearly separate and style undivided.* Receptacle flattish, naked, or with filiform chaff. Pappus none.

1. *A. artemisiæfolia*, L. RAGWEED. ROMAN WORMWOOD. A hairy or roughish-pubescent, branching annual, 1° to 3° high, common in dry soils, and a troublesome weed in gardens and fields not only everywhere throughout our area, but extending to British Columbia, Mexico, and South America, and introduced as a weed in Europe. Leaves 1 to 2-pinnatifid, petioled, 2' to 4' long, mostly alternate, lower ones opposite, thin, smoothish, pale green above, paler or hoary beneath. Sterile heads in terminal racemes 3' to 6' long. Fruit obovoid or subglobose, 1'' to 2'' long, crowned with 4 to 6 sharp teeth. Variable. Called also *Hogweed, Bitterweed*, etc. July to Oct.

2. *A. trifida*, L. GREAT RAGWEED. HORSEWEED. HORSE-CANE. A very tall annual, common in moist soil and along river banks from Me. to Fla. west to Minn., Neb., Col., and Ark. Stem stout, rough, hairy, sometimes glabrous, 3° to 16° high (!). Leaves opposite, deeply 3-lobed, lobes oval-lanceolate, acuminate, serrate; lower ones 6' to 12' long. Sterile racemes 3' to 10' long. Fruit obovate, 3'' to 4'' long, with conic beak and 5 to 6 tubercled ribs. Var. *integrifolia*, T. and G., apparently only a smaller form with upper leaves or all of them simply oval or ovate, without lobes. July to Oct.

XIX. XANTHIUM, Tourn. COCKLEBUR. CLOTBUR. Coarse annuals, mostly American, now widely dispersed weeds, with low, branching stems, alternate, usually lobed or toothed leaves, and green or yellowish, *monœcious flowers, the sterile and fertile in separate heads, arranged nearly as in Ambrosia.* Sterile involucre and flowers as in *Ambrosia*, but with the *scales distinct, in 1 to 3 rows, and the receptacle cylindric.* *Fertile involucre* closed, oblong, or ovoid, 2-beaked, and *armed with hooked prickles, making it a bur, 2-celled, each cell containing 1 akene.* Pappus none.

Leaves tapering at both ends, with 3-forked spines near their axils No. 1
Leaves with cordate or broad base, without spines Nos. 2, 3

1. *X. spinosum*, L. SPINY OR THORNY COCKLEBUR. An unsightly, spiny weed, with ascending or erect, branching stem, 1° to 2° high, naturalized from Tropical America (?) or from the Old World (?) in waste places from Mass. to Ill. south to Fla. and Tex. Leaves lanceolate or ovate-lanceolate, narrowed to a short petiole, often lobed or cut, or the upper entire, acute, or acuminate, 2' to 5' long, whitish-downy beneath and

from Mich. to Minn. and Neb. south to Ga. and La., and also escaped from cultivation eastward and naturalized near N. Y. City. Leaves large, thin, rough, ovate or deltoid-ovate, coarsely toothed, the largest 6' to 14' long, opposite; the upper connate-perfoliate, entire, *united by their bases into a cup*; the lower abruptly contracted into winged petioles with connate bases. Heads 2' to 3' wide, cymosely arranged on long peduncles terminating the branches. Rays 20 to 30, 1' long. Outer scales ovate, spreading or erect. Akenes obovate, 6'' long, winged, notched. Called also *Ragged Cup*. July to Sept.

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XVII. IVA, L. Coarse, herbaceous, or shrubby North American plants, with thick leaves, the lower opposite, and small, nodding heads of greenish-white flowers, axillary and solitary, or in spikes, racemes, or panicles. *Heads discoid, monœcious. Marginal flowers 1 to 5, pistillate, fertile, with or without a small, tubular corolla; inner, with funnelform corolla, stamens and undivided style, sterile.* Anthers scarcely united. Receptacle small, chaffy. Involucral scales few, rounded. Pappus none. Akenes obconic, glabrous.

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1. *P. integrifolium, L.* AMERICAN FEVERFEW. PRAIRIE DOCK. A rough-pubescent herb, with erect, stout, striate, pubescent, or glabrous stem, 2° to 4° high, in dry soils from Md. to Minn. south to Ga., Mo., and Tex. Leaves coriaceous, somewhat hispid, roughish, oblong, or ovate, crenate-dentate, or the lower cut-lobed toward the base; radical ones long-petioled, 4' to 12' long; upper ones smaller, sessile. Heads many, in a dense, 1° t, terminal corymb. Flowers white or whitish. June to Sept.

XVII. IVA, L. Coarse, herbaceous, or shrubby North American plants, with thick leaves, the lower opposite, and small, nodding heads of greenish-white flowers, axillary and solitary, or in spikes, racemes, or panicles. *Heads discoid, monœcious. Marginal flowers 1 to 5, pistillate, fertile, with or without a small, tubular corolla; inner, with funnelform corolla, stamens and undivided style, sterile.* Anthers scarcely united. Receptacle small, chaffy. Involucral scales few, rounded. Pappus none. Akenes obconic, glabrous.

1. *I. frutescens, L.* MARSH ELDER. HIGH-WATER SHRUB. A shrubby or herbaceous, nearly smooth perennial, with stem 3° to 8° high, paniculately branching above, common along salt marshes and on muddy coasts from Mass. to Fla. and Tex.; more shrubby south, more herbaceous north. Leaves fleshy, oval, or lanceolate, coarsely serrate; the lower 4' to 6' long; the upper lance-linear and linear, entire, gradually diminishing in size and width. Heads on short pedicels subtended by the bract-like upper leaves in paniculate racemes. Involucral scales 5, rounded, distinct. Fertile flowers 5; corollas tubular. Akenes 5. July to Sept.

XVIII. AMBRÒSIA, L. Coarse annual or perennial herbs, with alternate or opposite, mostly lobed or dissected leaves,

and *small heads of green, mostly monœcious flowers, the fertile and sterile in separate heads.* Fertile heads in sessile clusters of 1 to 3, in the axils of leaves or bracts at the foot of the spikes or racemes of the sterile ones. *Fertile involucre (fruit) more or less top-shaped, closed, resembling an akene, entire, or 4 to 8-toothed, containing a single, apetalous, pistillate flower.* *Sterile involucre cup-shaped or saucer-shaped, open, of 5 to 12 united scales, containing 5 to 20 barren flowers with funnellform corollas;* anthers nearly separate and style undivided. Receptacle flattish, naked, or with filiform chaff. Pappus none.

1. *A. artemisiæfolia*, L. RAGWEED. ROMAN WORMWOOD. A hairy or roughish-pubescent, branching annual, 1° to 3° high, common in dry soils, and a troublesome weed in gardens and fields not only everywhere throughout our area, but extending to British Columbia, Mexico, and South America, and introduced as a weed in Europe. Leaves 1 to 2-pinnatifid, petioled, 2' to 4' long, mostly alternate, lower ones opposite, thin, smoothish, pale green above, paler or hoary beneath. Sterile heads in terminal racemes 3' to 6' long. Fruit obovoid or subglobose, 1'' to 2'' long, crowned with 4 to 6 short teeth. Variable. Called also *Hogweed*, *Bit-terweed*, etc. July to Oct.

2. *A. trifida*, L. GREAT RAGWEED. HORSEWEED. HORSE-CANE. A very tall annual, common in moist soil and along river banks from Me. to Fla. west to Minn., Neb., Col., and Ark. Stem stout, rough, hairy, sometimes glabrous, 3° to 16° high (!). Leaves opposite, deeply 3-lobed, lobes oval-lanceolate, acuminate, serrate; lower ones 6' to 12' long. Sterile racemes 3' to 10' long. Fruit obovate, 3'' to 4'' long, with conic beak and 5 to 6 tubercled ribs. Var. *integrifolia*, T. AND G., apparently only a smaller form with upper leaves or all of them simply oval or ovate, without lobes. July to Oct.

XIX. XANTHIUM, Tourn. COCKLEBUR. CLOTBUR. Coarse annuals, mostly American, now widely dispersed weeds, with low, branching stems, alternate, usually lobed or toothed leaves, and green or yellowish, *monœcious flowers, the sterile and fertile in separate heads*, arranged nearly as in *Ambrosia*. Sterile involucre and flowers as in *Ambrosia*, but with *the scales distinct, in 1 to 3 rows, and the receptacle cylindric.* *Fertile involucre closed, oblong, or ovoid, 2-beaked, and armed with hooked prickles, making it a bur, 2-celled, each cell containing 1 akene.* Pappus none.

Leaves tapering at both ends, with 8-forked spines near their axils No. 1
Leaves with cordate or broad base, without spines Nos. 2, 3

1. *X. spinosum*, L. SPINY OR THORNY COCKLEBUR. An unsightly, spiny weed, with ascending or erect, branching stem, 1° to 2° high, naturalized from Tropical America (?) or from the Old World (?) in waste places from Mass. to Ill. south to Fla. and Tex. Leaves lanceolate or ovate-lanceolate, narrowed to a short petiole, often lobed or cut, or the upper entire, acute, or acuminate, 2' to 5' long, whitish-downy beneath and

white-veined above, with a straw-colored, 3-pronged spine 9" to 12" long, near the axil. Fruit or bur 4" to 6" long, with short, subulate beaks. Aug. to Nov.

2. *X. strumarium*, L. BROAD-LEAVED COCKLEBUR. A coarse, rough weed, with bristly, branching stem, 2° to 3° high, naturalized from Europe (?) or Asia (?) in old fields, barnyards, and waste places throughout our area. Leaves on long, slender petioles, broadly ovate, 3-ribbed, cordate, lobed, dentate, 5' to 10' long, green and roughish above and beneath. *Bur* glabrous or puberulent, 6" to 9" long, with 2 straight conical-subulate beaks. Aug. to Oct.

3. *X. Canadense*, MILL. AMERICAN COCKLEBUR. A plant similar to No. 2, common along rivers, sea and lake shores, and waste places from Me. to N.C. and from the Miss. to the Dakotas, Nev., and Tex. Stem stouter, often brown-spotted. *Bur* usually 1' long, hispid, and with the 2 stout beaks usually hooked or incurved. Aug. to Oct.

XX. ZINNIA, L. Annual or perennial, American, chiefly Mexican herbs, with opposite, mostly sessile and entire leaves, and solitary terminal heads of showy tubular and radiate, variously colored flowers. Disk flowers perfect, with 5 velvety lobes. Rays pistillate, persistent on the akenes. Involucral scales imbricated, in several rows. Receptacle conical or at length cylindrical, its chaff clasping the disk flowers. Akenes of disk compressed, their pappus of 1 to 2 awns; those of the rays 3-angled, without pappus.

1. *Z. multiflora*, L. (*Z. pauciflora*, L.) An annual, escaped from cultivation and found in fields and waste places from Fla. to Tex. and north to N.C. Stem erect, hairy, simple, or branching, 1° to 2° high. Leaves lanceolate to oblong-ovate, 1' to 2' long, abrupt or subcordate at base, scabrous. Peduncles as long as the leaves, enlarged upward, and hollow. Heads with obovate to narrowly spatulate, red, purple, or yellow rays. Pales obtuse, entire. Akenes of disk 1-awned. July to Sept.

2. *Z. elegans*, L. YOUTH AND OLD AGE. A Mexican annual, 1° to 3° high, the parent of most of the garden Zinnias, with ovate-elliptic, clasping leaves 2' to 3' long, peduncles longer than the leaves and smaller upward, and heads 2' to 5' wide. Rays reflexed, originally in a single series, purple or lilac, but by cultivation double and of nearly every color, except blue and green, from white to dark purple. Disk flowers originally yellow or orange, but in the double forms nearly or entirely wanting. Pales serrated. Akenes of disk 2-awned. July to Oct.

XXI. HELIOPSIS, PERS. American perennials, except one tropical annual, with loosely branching stems, opposite, petioled, 3-ribbed, mostly serrate leaves, and large, terminal, peduncled heads of yellow disk and ray flowers. Disk flowers perfect. Rays pistillate, fertile. Involucral scales nearly equal, imbricated, in 2 or 3 rows. Receptacle conic, chaffy; pales linear or lanceolate, embracing the disk flowers. Akenes 4-sided, truncate, thick. Pappus none, or a low crown, or 2 to 4 teeth.

1. *H. laevis*, PERS. OXEYE. FALSE SUNFLOWER. A symmetrical, smooth, and glabrous herb, 3° to 5° high, with angular, striate, branching stem, common in hedges, thickets, and open places from N.Y. to Ill. south to Fla. and Ala. Leaves light green, thinnish, ovate-oblong or ovate-lanceolate, acute or acuminate, usually abrupt at base, 3' to 6' long, sharply and coarsely serrate, sometimes whorled in 3's. Heads 18'' to 30'' wide. Rays bright yellow, 9'' to 12'' long. Akenes glabrous. Pappus none, or 2 to 4 obscure teeth. July to Sept.

2. *H. gracilis*, NUTT. SLENDER OXEYE. A smaller species than No. 1, with slender stem, 1° to 2° high, found in dry and shady grounds from Ga. and western Fla. to Ark. and La. Stem and leaves somewhat rough, the latter ovate-lanceolate to lanceolate, 2' to 3' long, with rather wedge-shaped base. Heads much smaller, 3'' to 4'' long; rays fewer, 5 to 10, 5'' to 8'' long. Akenes pubescent on the angles when young, crowned with a chaffy pappus, or with 2 or 3 conspicuous teeth. Aug.

3. *H. scabra*, DUNAL. ROUGH OXEYE. A plant, 2° to 4° high, resembling No. 2 in the roughness of its stem and leaves and in its akenes and pappus, found usually in dry soils from Me. to Minn. south to N.J., Ill., and Ark. Leaves firm, rough on both sides, broadly ovate, and subcordate to ovate-lanceolate, acute or acuminate, 2' to 5' long, sharply serrate, or the upper entire. Heads 24'' to 30'' wide. Rays 1' long or more. June to Sept.

XXII. TETRAGONOTHECA, L. Erect, perennial, North American herbs, with opposite, sessile, sometimes coarsely toothed leaves, and large, solitary, terminal heads of pale yellow disk and ray flowers. Disk flowers perfect, fertile. Rays 6 to 9, pistillate, fertile. Involucre double; the outer of 4 large, leafy bracts united below into a 4-angled cup; the inner of small, chaff-like scales, equaling in number and partly clasping the akenes of the rays. Receptacle conical, chaffy. Akenes very thick, truncate. Pappus none.

1. *T. helianthoides*, L. A coarse, viscid, villous herb, with stout, simple, or branching stem, 1° to 2° high, found in dry and sandy soils from Va. to Fla. and Ala. Leaves ovate or ovate-oblong, sessile, coarsely, unequally dentate or repand-toothed, 3' to 5' long, acute, with narrow base. Heads few, 2' to 3' wide, on long peduncles. Outer scales and rays about 1' long. April to June.

XXIII. ECHINACEA, MOENCH. PURPLE CONE-FLOWER. Erect, perennial, North American herbs, with stout, simple, or branched stems, from thick, black roots, alternate or opposite, 3 to 5-ribbed, entire or toothed leaves, and large, solitary, long-peduncled heads of disk and ray flowers. Disk flowers purplish, perfect, fertile. Rays purple or purplish, neutral, or imperfectly pistillate, sterile. Involucral scales lanceolate, imbricated, in 2 or 3 rows, spreading or appressed. Receptacle conical, chaffy, the *pales rigid*, keeled, *mucronate*, longer than the disk flowers, whence the generic name. Akenes 4-angled, thick, short. Pappus none, or a small, toothed border.

1. *E. purpurea*, MOENCH. A showy plant, 3° to 5° high, usually smooth and glabrous, or with the leaves and sometimes the stem rough or more or less hispid, found in moist, rich soils from western Pa. and Va. to Iowa south to Ala. and La. Lower and radical leaves on slender petioles, *ovate, 5-veined, dentate*, 3' to 8' long; upper ones *ovate-lanceolate to lanceolate, 3-veined, sessile or nearly so, sometimes entire*. Rays 12 to 20, dull purple, or rarely varying to white, 1' to 3' long, spreading or drooping. The pungent root is known in popular medicine as *Black Sampson*. Very variable, possibly running into No. 2. July to Oct.

2. *E. angustifolia*, DC. A bristly, hairy plant, 1° to 3° high, found on prairies from Ill. to Minn. south to Ala. and Tex. *Leaves lanceolate to linear-lanceolate, acute and narrowing to each end, 3-veined, entire*, 3' to 8' long, the lower and radical on slender petioles, the upper on short ones, or sessile. Heads and flowers as in No. 1, but usually with shorter, narrower, and paler rays. June to Sept.

XXIV. RUDBÉCKIA, L. CONE-FLOWER. Chiefly perennial, North American herbs, with alternate leaves, and large, terminal, peduncled heads, of usually purplish disk and yellow ray flowers. Disk flowers perfect, fertile. Rays neutral. Involucral scales leaf-like, in 2 or more rows, nearly equal, spreading. Receptacle conical, convex or columnar. Chaff concave, not mucronate or rigid. Akenes usually 4-angled. Pappus none or minute, crown-like.

Leaves much divided. Disk oblong	No. 1
Leaves not much divided. Some 3-lobed. Disk rounded	No. 2
Leaves not divided. Disk conical or convex, etc.	Nos. 3 to 5
Leaves not divided, some of them clasping	No. 6

1. *R. laciniata*, L. **TALL CONE-FLOWER.** A showy perennial, with smooth, round, branching stem, 6° to 8° high, common in moist and low thickets throughout our area. Leaves thinnish, smooth, or slightly rough; radical and lower ones long-petioled, pinnately 5 to 7-divided, the segments 3-lobed or cut; upper, 3 to 5-parted, with ovate-lanceolate lobes; the uppermost and those on the branches much smaller, few-toothed, or entire. Largest leaves 8' to 12' long. Heads 3' to 4' wide, several or many, long-peduncled. *Disk dull, greenish-yellow, globular or hemispherical, becoming oblong or columnar in fruit*. Rays 6 to 10, oblanceolate, 1' to 2' long, bright yellow, drooping. Chaff truncate, with downy tip. Pappus a minute crown. Called also *Thimbleweed*. Var. *humilis*, GRAY, 1° to 2° high, with some of the radical leaves undivided and roundish, with smaller heads and rays, is common in open woods along the mts. from Va. to Ga. and Tenn. July to Sept.

2. *R. triloba*, L. A rough, slightly pubescent, hairy or hirsute biennial, with stem 2° to 5° high, and slender, spreading branches, found in dry or moist soils from N.J. to Mich. and Mo. south to Ga. and La. *Leaves bright green, thin, rough, 2' to 4' long, 3-ribbed; lower ones petioled, mostly 3-lobed or 3-parted, with lanceolate, serrate, acuminate lobes; upper ones ovate to lanceolate, narrowed to a sessile or somewhat clasping base, serrate or entire; radical ones pinnately parted or undivided*. Heads many, corymbed, 2' wide, with dark purple, hemispherical to ovoid disk, and 8 to 10 oval or oblong, deep yellow rays with orange base. Chaff dark purple, awned. Aug. to Oct.

3. *R. hirta*, L. BLACK-EYED SUSAN. A rough, bristly-hairy, *showy biennial*, or sometimes *annual*, with simple or somewhat branched, *often tufted, stout* stems, 1° to 2° high, in dry, open grounds, originally on prairies from Ontario to the Gulf of Mexico, but now distributed as a weed in dry fields throughout our area. Stems nearly simple, or branching near the base, each stem or branch leafless toward the top. Leaves thick, ovate-spatulate, 3-veined, petioled, mostly entire, 2' to 5' long; upper ones sessile, ovate-lanceolate. Heads solitary, on long peduncles, with 12 to 15 orange rays 1' long, and a dull purple or brown, globose-ovoid disk, the chaff acute and bearded at the top. Pappus none. Scales much shorter than the rays. As a biennial, it flowers earlier. May to Sept.

4. *R. fulgida*, AIT. A hairy *perennial*, with *slender*, simple stem, 1° to 2° high, or with slender branches, naked above, bearing solitary heads, in dry soils from N.J. to Mo. south to Ga. and Tex. Leaves strigose-pubescent, entire or somewhat serrate, with distant teeth; radical and lower ones oblong-spatulate, 2' to 4' long, narrowed into winged petioles; upper, lanceolate or oblong, sessile or clasping. Heads few. Rays 12 to 14, linear, 1' long, as long as the leafy scales, orange-yellow, or with an orange base. Disk globose or ovoid, brownish-purple. Chaff obtuse, with glabrous tip. Pappus a short, toothed crown. Variable. Aug. to Oct.

5. *R. speciosa*, WENDEROTH. SHOWY CONE-FLOWER. A roughish-hairy *perennial*, 1° to 4° high, with slender, erect, elongated branches, naked above and terminating in single, showy heads; native in dry or moist soils from N.J. to Mich. and Mo. south to Ala. and Ark., and long cultivated in gardens as *R. fulgida*, etc. Leaves bright green, ovate-lanceolate or lanceolate, irregularly serrate, or some laciniately dentate, acute or acuminate; radical and lower stem ones oblong or ovate, 4' to 6' long, 3 to 5-nerved, abruptly contracted into long, margined petioles. Rays 12 to 20, elongated, at length 18" long, bright yellow, usually with orange base. Disk dark purple, depressed-globose. Aug. to Oct.

6. *R. amplexicaulis*, VAHL. A smooth, somewhat glaucous, leafy *annual*, with grooved stem, 1° to 2° high, and ascending branches, in wet soils from Mo. to La. and Tex. Leaves strictly 1-ribbed, reticulate-veiny, entire to sparingly serrate; lower ones oblong-spatulate, sessile, with a tapering base; upper, oblong or ovate, with clasping base. Heads solitary, terminal, long-peduncled, 18" to 24" wide. Scales few, small. Rays yellow, often with brown-purple base. Disk brownish, oblong-ovoid, often 1' high. Receptacle slender. Akenes not angled, striate. Pappus none. June to Aug.

XXV. HELIÁNTHUS, L. SUNFLOWER. Coarse, stout, usually tall, annual or perennial, New World herbs, with opposite or alternate, simple leaves, and peduncled, solitary or corymbed heads, with yellow rays and yellow, brown, or purple disk. Disk flowers perfect. Rays neutral. Involucral scales imbricated, in several rows. Receptacle flat, convex or conical; chaff persistent, embracing the laterally compressed, *somewhat 4-angled*, but *not winged* or *margined* akenes. Pappus of 2 very deciduous, chaffy scales, with sometimes 2 or more intermediate, shorter ones. The species are very variable, often hybridizing in their wild forms, and hence often difficult to delimit. Many are in ornamental cultivation.

Disk purple or purplish. (a)

Disk yellow or yellowish. (b)

a. Leaves broad. Annual	No. 1
a. Leaves narrow. Perennial	No. 2, 3
b. Leaves chiefly alternate	No. 4, 5, 6
b. Leaves chiefly alternate above	No. 7
b. Leaves opposite, divaricate	No. 8

1. *H. annuus*, L. **COMMON SUNFLOWER.** An annual, with stout, erect, rough, or hispid stem, 3° to 6° high, or in cultivation 6° to 15°, branched above, native of plains and alluvial grounds from Minn. to Tex. west to the Pacific, but now cultivated the world round for use and for ornament. Leaves petiolate, ovate, acute, 3-ribbed, dentate or denticulate, the lower cordate, 3' to 12' long, rough on both sides, only the lowest opposite. Heads, in the wild state, only 3' to 4' wide, in cultivation 6' to 12', few or many, nodding. Disk brown or dark purple. Receptacle flat; chaff 3-toothed. Involucral scales ovate, acuminate or aristate, ciliate below. Several varieties with flowers all radiate are cultivated. Its seeds (fruit) yield food and an edible oil, its flowers a dye, its receptacles and stalks a textile fiber, for most of which purposes it was found by early French explorers to be used by the American Indians. It is now extensively cultivated for food and the oil of its seeds in Russia, India, Egypt, Turkey, Germany, Italy, and France. July to Sept.

2. *H. angustifolius*, L. **NARROW-LEAVED SUNFLOWER.** An eastern perennial, with slender, *sparsely leafy, usually rough* stem, 2° to 6° high, common in wet, sandy places, and low, pine barrens from L.I. to Ky., Fla., and Tex., mostly near the coast. Leaves alternate above, opposite below, thickish, firm, sessile, lance-linear to linear, 1-nerved, 2' to 7' long, tapering to a long point, entire, revolute when dry. Heads 2' to 3' wide, few, long-peduncled. Rays 12 to 20. Disk purple or brownish. Scales lance-linear, acute or acuminate, spreading. Chaff linear. Aug. to Oct.

3. *H. orgyâlis*, DC. **LINEAR-LEAVED SUNFLOWER.** A western perennial, with slender, *smooth, and very leafy stem*, 6° to 10° high, native on dry plains from Neb. to Ark. and Tex., and extensively cultivated for ornament. Leaves mostly alternate, the lower opposite, sessile, entire, *linear to almost filiform*, or the lowest short-petioled, distantly toothed and lanceolate, acuminate, 1-nerved, 4' to 16' long. Heads many, 2' wide, at the ends of short, slender branches, producing in cultivated forms a spike-like, terminal panicle 3° to 4° long. Rays 10 to 20. Disk dark purple or brown. Scales narrowly lanceolate, squarrose, ciliate. Specific name (*orgyâlis*) refers to the height, 6°. Sept. to Oct.

4. *H. giganteus*, L. **TALL OR GIANT SUNFLOWER.** A perennial, with rough or hairy stem, branched above, 3° to 12° high, common in low thickets, swamps, and wet meadows from Me. to N. Dak. south to Fla., Neb., and La. Leaves chiefly alternate, especially above, but sometimes all opposite, lanceolate, 2' to 6' long, acuminate, serrulate or nearly entire, narrowed and ciliate at base, nearly sessile, rough and green on both sides. Heads 18" to 30" wide, somewhat corymbd, on long peduncles. Rays 15 to 20, *pale yellow*, 1' long. Scales lanceolate-linear, *hairy, strongly ciliate*, squarrose, usually as long as the width of the *yellowish* disk. Pappus of 2 awl-shaped awns. Var. *subtuberâsus*, BRITTON, ranging from Mich. to Minn. south to Ala. and La., with broader, more sharply serrate, and mainly opposite leaves, has thick, fleshy roots, the so-called "edible tubers," "the Indian potato of the Assiniboine tribe." Aug. to Oct.

5. *H. grosse-serrâtus*, MARTENS. **SAW-TOOTH SUNFLOWER.** A tall perennial, of dry plains and prairies from Ohio to S. Dak., Mo., and Tex., similar to No. 4, and possibly running into it, *but with smooth, glabrous, and glaucous stem*, 6° to 10° high, and *leaves elongated-lanceolate or ovate-*

lanceolate, long-acuminate, sharply serrate or denticulate, 4' to 8' long, on slender petioles, rough above, whitish and softly pubescent beneath. Heads as in No. 4, but with deep yellow rays and lance-awl-shaped, slightly ciliate scales. In ornamental cultivation. Aug. to Oct.

6. *H. tuberosus*, L. JERUSALEM ARTICHOKE. A perennial herb, with tuber-bearing, fleshy rootstock, and hirsute or pubescent stem, 5' to 10' high, branching at the top, common in moist soils from Me. to N. Dak. south to Ga. and Ark., and often cultivated, as it was by the aborigines, for its reddish or yellow, edible tubers. Leaves mostly alternate, opposite below, dull green, firm, thickish, ovate or oblong-ovate, triple-ribbed at base, acuminate, petioled, serrate, 4' to 8' long, rough above, finely pubescent or ashy-gray beneath. Heads several or many, 2' to 3' wide. Rays 12 to 20. Disk yellow. Chaff acute. Akenes pubescent. The epithet *Jerusalem* in the common name is a corruption of *Girasole*, the Italian for sunflower. Called also *Canada Potato*. Sept. to Oct.

7. *H. decapetalus*, L. THIN-LEAVED or TEN-RAYED SUNFLOWER. A smooth, glabrous, slender-stemmed perennial, 2° to 5° high, with puberulent branches above, common in moist copses and along streams from Me. to Mich. south to Ga. and Ky. Leaves thin, smooth or roughish, upper mostly alternate, lower opposite, ovate to ovate-lanceolate, acuminate, abruptly contracted into a slender, margined petiole, serrate, 3' to 6' long. Heads many, 2' to 3' wide. Rays light yellow, about 10 (decapetalus), usually more. Scales lanceolate-linear, acuminate, hirsute-ciliate, spreading, often leaf-like, and the outer longer than the yellow disk. Long cultivated for ornament, especially the horticultural variety *multidorsus*, in many double-flowered forms. Aug. to Sept.

8. *H. divaricatus*, L. WOODLAND SUNFLOWER. DIVARICATE SUNFLOWER. A common perennial, of dry woodlands, thickets, and barrens from Me. to Fla. west to Neb. and La., with smooth, slender, glabrous stem, 2° to 5° high, simple nearly to the top. Leaves usually all opposite and horizontally divaricate (divaricatus), sessile or nearly so, ovate-lanceolate, 3' to 6' long, 3-ribbed, tapering from a rounded or truncate base to a long, acute point, serrate, thickish, firm, green and rough on both sides, or sometimes smooth or pubescent beneath. Heads about 30'' wide, few, in a slender, 2 to 3-forked panicle. Rays 8 to 12, 1' long. Disk yellow, 6'' wide. Scales lanceolate, outer spreading, equaling the disk. July to Sept.

XXVI. VERBESINA, L. CROWNBEARD. Annual or perennial, New World herbs, or in the tropics sometimes shrubs, with alternate or opposite, often decurrent leaves, and corymbed or solitary heads of yellow or white disk and ray flowers, or the latter sometimes wanting. Disk flowers perfect. Rays pistillate or neutral, few, or sometimes none. Receptacle convex or conical, chaffy, the chaff embracing the flowers. Akenes compressed, or those of the ray 3-sided, winged or wingless, 2-awned. Scales in 2 or more rows, imbricated, erect.

1. *V. occidentalis*, WALT. (*V. SIEGESBÆCKIA*, Mx.) SMALL YELLOW CROWNBEARD. A robust, rather coarse perennial, with narrowly 4-winged, mainly glabrous, branching stem, 4° to 7° high, common in dry fields and thickets, and on hillsides and roadsides, from southern Pa. to Ill. south to Fla. and Ga. Leaves opposite, thin, often pubescent beneath, triple-nerved, ovate or lanceolate to oblong-lanceolate, serrate, acuminate, 4' to 8' long, tapering to a slender, margined, or naked petiole. Heads 6'' to 12'' wide, many, in terminal, cymose corymba. Rays 1 to 5, or rarely

none, yellow, lanceolate, pistillate, usually fertile. *Disk yellow. Scales* obtuse, lanceolate. Akenes wingless. Pappus of 2 awns. Aug., Sept.

2. *V. Virginica*, L. SMALL WHITE OR VIRGINIA CROWNBEARD. A perennial; with simple or branched, *downy-pubescent stem*, 3° to 5° high, *somewhat winged or terete*, found in dry soils from Pa. (?) and Va. to Mo. south to Fla. and Tex. *Leaves alternate*, roughish above, pubescent beneath, lanceolate or lance-ovate, subserrate, acute or acuminate, tapering to the base. Heads 6'' to 10'' wide, in compound corymbs. Rays 3 to 4, *oval, white*, pistillate. *Disk white. Akenes winged or wingless*, with or without 2 awns. Aug., Sept.

3. *V. helianthoides*, Mx. (ACTINOMERIS HELIANTHOIDES, NUTT.) SUN-FLOWER CROWNBEARD. A rough perennial, with widely winged, hairy, usually simple stem, 2° to 4° high, with the aspect of *Helianthus*, found on dry prairies and barrens and in thickets from Ohio to Iowa and Mo. south to Ga. and Tex. *Leaves alternate*, or only the lower opposite, ovate to ovate-lanceolate, sessile, decurrent, 2' to 4' long, rough above, pubescent beneath. Heads few or solitary, 2' to 3' wide. Rays 8 to 15, pistillate or neutral, usually sterile, oblong, yellow. *Disk yellow. Scales erect. Akenes broadly winged*, with 2 awl-shaped awns. June, July.

XXVII. ACTINOMERIS, NUTT. Tall, branching, North American perennials, with alternate or opposite, ovate to lanceolate, usually serrate, often decurrent leaves, and corymbed, radiate heads of yellow or white flowers. *Disk flowers perfect. Rays neutral*, 4 to 14, rarely none. Scales few, nearly equal, leaf-like. Receptacle convex or conical, becoming globose in fruit, chaffy. Akenes compressed laterally, flat, obovate, usually winged. Pappus of 2 persistent awns.

1. *A. squarrosa*, Nutt. An unsightly herb, with somewhat pubescent, simple or branched, usually winged stem, 5° to 10° high, common in rich soils from N.J. and western N.Y. to Iowa south to Fla. and La. *Leaves alternate*, or the lower opposite, sessile or short-petioled, oblong-lanceolate or lanceolate, acute or acuminate, with similar base, 6' to 12' long, serrate, rough, decurrent. Heads many, 8'' to 12'' wide, *squarrose, with spreading or recurved linear or narrowly spatulate scales. Flowers all yellow. Rays 4 to 8, 2'' to 3'' long. Akenes mostly broad-winged. Pappus of 2 awns in the disk, or 3 in the rays. Aug., Sept.*

2. *A. alba*, T. AND G. A plant with smooth or pubescent stem, often narrowly winged above, 4° to 8° high, found in moist, rich soils from S.C. and Ga. to La. *Leaves alternate*, lanceolate, 5' to 8' long, finely serrate. Heads 4'' to 5'' wide. *Disk flowers dull white. Rays none. Akenes broadly or narrowly winged or wingless. Awns of pappus slender, sometimes 3 or 4. Aug. to Oct.*

XXVIII. COREÓPSIS, L. TICKSEED. COREOPSIS. Annual or perennial herbs, with mostly opposite leaves, and long-peduncled heads of showy flowers. *Disk flowers perfect, fertile, yellow, brown, or purple. Rays about 8, rarely wanting, neutral, very large, yellow, parti-colored or rose-colored. Involucre of 2 distinct rows of about 8 scales each; the outer narrow, leaf-like, and somewhat spreading; the inner broader,*

more or less membranous, and appressed. Receptacle flat, chaffy. Akenes obcompressed (*i.e.* compressed parallel with the involucreal scales), emarginate, often winged. Pappus usually 2 teeth or awns not barbed downwardly, sometimes none.

a. Rays coarsely toothed — usually broad and wedge-shaped. (b)

a. Rays entire or nearly so. (c)

b. Disk purple. Rays yellow with darker base. Nos. 1, 2

b. Disk yellow. Rays yellow, throughout. Nos. 3, 4, 5

c. Leaves opposite, sessile, apparently whorled in 6's Nos. 6, 7, 8

c. Leaves opposite, petioled. Tall herbs No. 9

1. *C. tinctoria*, NUTT. COMMON GARDEN COREOPSIS OR TICKSEED. A smooth, branching annual, 2° to 4° high, native of moist soils from Minn. to La. and Tex., and westward, common in gardens everywhere and somewhat escaped to waste places eastward. Leaves 1 to 2-pinnately divided into linear, usually entire segments, or the upper ones linear and entire. Heads 9" to 15" wide, on slender peduncles. Disk dark purple. Rays wedge-shaped, coarsely toothed at the end, yellow, with purple or brown base, or sometimes purple or brown throughout. Inner scales dark colored, ovate or oblong, 3 to 5 times as long as the outer ones. Akenes oblong, incurved, wingless, without teeth or awns. Flowering all summer. May to Sept.

2. *C. Drummondii*, T. AND G. DRUMMOND'S COREOPSIS. GOLDEN WAVE. A low, pubescent or sometimes glabrous annual, native of sandy soils in Tex., and common in gardens. Leaves pinnately divided, with ovate, broadly elliptical or lanceolate divisions, those of the upper ones linear. Heads 1' to 2' wide. Rays broadly wedge-shaped, 5-toothed at the end, yellow, with dark base. Outer scales linear, as long as the inner. Akenes obovate or oval, incurved, wingless, toothless, awnless.

3. *C. lanceolata*, L. LANCE-LEAVED COREOPSIS. A low perennial, with smooth or hairy stem, 1° to 2° high, including its long, simple, naked peduncles, native in rich or moist soils from Mich., Ill., and Mo. to Va., Fla., and La., and also cultivated. Leaves usually few, opposite or radical, the latter on slender petioles, narrowly oblong or spatulate, 2' to 6' long, entire, or rarely with 1 or 2 small, lateral lobes; stem leaves sessile, lanceolate to nearly linear, entire. Heads showy, 18" to 30" wide, few or solitary, on elongated peduncles often 1° long. Disk and 4 to 5-toothed, wedge-shaped rays yellow. Akenes oblong or nearly orbicular, strongly incurved, broadly winged, with 2 teeth. June to Aug.

4. *C. auriculata*, L. LOBED COREOPSIS. A pubescent or glabrous perennial sometimes stoloniferous, with slender, weak, decumbent or ascending, simple or somewhat branching stems, 6' to 15' high or long, found in rich woods and on banks from Va. to Ill. south to Fla. and La., and also in gardens. Leaves roundish-ovate, entire, 1' to 2' long; lower ones on slender petioles, sometimes with 2 or more small, lateral lobes at the base (*auriculata*); upper, nearly or entirely sessile. Heads 12" to 18" wide, few, on long, slender peduncles. Disk and 4-toothed, wedge-shaped rays yellow. Akenes oval, with involute wings. Variable. May to Aug.

5. *C. palmata*, NUTT. STIFF COREOPSIS. A very leafy perennial, with *stiff*, glabrous, angled, striate, nearly simple, but sometimes much-branched stem, 1° to 3° high, found on dry prairies and in thickets from Ill. to Minn. and Neb. south to La. and Tex. Leaves thick, *rigid*, sessile, wedge-shaped in outline, 2' to 3' long, *palmately 3-cleft to or below the middle*, the broadly linear lobes acute, entire, rough-edged; uppermost leaves undivided and entire. Heads few or solitary, 18" to 30" wide, on short peduncles. Disk and obovate-oblong, usually 3-toothed rays yellow. Akenes narrowly elliptic, somewhat winged, incurved. June, July.

6. *C. senifolia*, Mx. (*C. MAJOR*, WALT.) A minutely downy or glabrous perennial, of dry, sandy woodlands from Va. to Fla., with strict, slender, angular stem, 2° to 3° high, branching above, and opposite, sessile, ternately divided leaves, resembling whorls of six leaves each (*senifolia*). Leaflets sessile, ovate-lanceolate, acute, entire, 2' to 4' long. Upper and rarely the lower leaves undivided and entire. Disk and rays yellow, the latter narrow, entire, 1' long. Outer and inner scales downy, nearly equal in length. Akenes elliptic, winged, with 2 deciduous teeth. Var. *stellata*, T. AND G., smooth and glabrous throughout, with linear-lanceolate or linear leaflets, occurs from W. Va. and Ky. to Ga. July, Aug.

7. *C. delphinifolia*, LAM. LARKSPUR COREOPSIS. A smooth or slightly pubescent perennial, of dry pine woods and barrens from Va. to Ga. and Ala., with stem 1° to 3° high, and the leaflets of its opposite, sessile, ternately divided leaves again parted into 2 to 5 linear, entire, acute, rather rigid segments, 1' to 2' long. Heads several or many, 18'' to 24'' wide. Disk brownish. Rays yellow, narrow, entire. Scales glabrous. Akenes narrowly winged, with 2 short teeth. Aug., Sept.

8. *C. verticillata*, L. WHORLED COREOPSIS. A smooth perennial, with slender, sparingly branched stem, 1° to 3° high, native in damp or dry soils from Ontario, Mich., and Neb. south to Md., N.C., Ky., and Ark., and cultivated in gardens. Leaflets of the opposite, sessile, ternately divided leaves 1 to 2-pinnately parted into narrowly linear or filiform segments. Disk dull yellow. Rays bright yellow, oblong-spatulate, 10'' to 12'' long. Akenes narrowly winged, with 2 short teeth. June to Sept.

9. *C. tripteris*, L. TALL COREOPSIS. A handsome perennial, with smooth, simple stem, corymbose at the top, 4° to 8° high, common in rich, moist woods and thickets from Pa. to Wis. south to Fla. and La. Leaves coriaceous, opposite, petioled, pinnately 3 to 5-divided, except the uppermost; leaflets lanceolate, acute, 2' to 5' long, entire, rough-edged, pinnately veined. Heads many, 12'' to 18'' wide, on slender peduncles. Rays oblong, obtuse, entire, yellow. Disk dull yellow, turning brownish. Outer scales linear, obtuse, much narrower than the inner ovate to lanceolate, acute ones. Akenes narrowly winged. Pappus none. July to Oct.

XXIX. BIDENS, L. BUR MARIGOLD. BEGGAR-TICKS. Annual or perennial herbs, with opposite, simple or compound leaves, and heads of mostly yellow disk and ray flowers, the latter sometimes rudimentary or wanting. Disk flowers perfect. Rays when present neutral, 3 to 8. Involucre double; outer scales usually large and leaf-like. Receptacle flat or flattish, chaffy. Akenes compressed, parallel with the scales (obcompressed), or somewhat 4-sided and slender. Pappus of 2 or more rigid, persistent, downwardly barbed awns.

Leaves compound. Akenes linear	. . . . .	No. 1
Leaves compound. Akenes flattened	. . . . .	No. 3
Leaves simple. Akenes flattened	. . . . .	Nos. 2, 4

1. *B. bipinnata*, L. SPANISH NEEDLES. A smooth, branching annual, 2° to 4° high, with bipinnately dissected leaves, common in damp soil and waste places from R.I. to Ill. south to Fla., and as a weed in cultivated ground everywhere, even to Mexico, Central America, and southern Europe and Asia. Leaves thin, petioled, ultimate segments ovate or lanceolate, toothed. Heads usually many, on long, slender peduncles. Rays 3 to 4, pale yellow, obovate, very short, sometimes none. Involucre narrow; outer and inner scales nearly equal. Akenes linear,

somewhat 4-sided, tapering upward, 5" to 9" long, the outer ones usually shorter and thicker. Pappus of 2 to 4, somewhat spreading, downwardly barbed awns. July to Sept.

2. *B. frondosa*, L. COMMON BEGGAR-TICKS. STICK-TIGHTS. A coarse, diffusely-branched annual, with smooth or somewhat pubescent stem, 2° to 6° high, common in moist soils, and as a troublesome weed in cultivated ground throughout our area, and introduced as a weed into Europe. Leaves thin, petioled, and, except the uppermost, pinnately 3 to 5-foliate, the leaflets lanceolate or broader, serrate, usually stalked. Heads erect. Outer scales leaf-like, much longer than the head, ciliate below. Rays none or inconspicuous. Akenes flat, obovate, with ciliate margins and 2 retrorsely barbed awns. Aug., Sept.

3. *B. cernua*, L. SMALLER BUR MARIGOLD. A nearly smooth annual, with usually erect, branched stem, 1° to 2° high, common in swamps, ditches, and other wet places from Me. to Va. and westward across the continent to Asia and Europe. Leaves simple, opposite, sessile, subconnate, lanceolate, coarsely and irregularly serrate, 3' to 6' long. Heads many, globous, nodding (*cernua*) while or after flowering, with or without 7 or 8 very short, pale or greenish-yellow rays. Outer scales leaf-like, longer than the membranous inner ones. Akenes flattened, wedge-shaped, with retrorsely hispid margins, and 2 to 4, generally 4, downwardly barbed awns. Aug. to Oct.

4. *B. chrysanthemoides*, Mx. LARGER BUR MARIGOLD. BROOK SUNFLOWER. A smaller annual than No. 3, 6' to 20' high, similar to it in habitat, foliage, and fruit, common from Me. to Minn. south to Fla. and La. It differs chiefly in having its heads erect, with 7 or 8 large, showy, golden-yellow, spreading rays. The outer involucreal scales also are no longer than the inner; the leaves rather minutely and evenly serrate and more decidedly connate at base, and the awns of the pappus are usually 2. Sept., Oct.

XXX. COSMOS, CAV. COSMOS. Annual or perennial, tropical American, chiefly Mexican herbs, with opposite, entire, lobed, or pinnately cut leaves, and solitary or panicled heads of flowers, differing from *Bidens* only in having the rays nearly always rose, crimson, or purple, rarely yellow, and the akenes distinctly beaked. Otherwise as in *Bidens*.

1. *C. bipinnatus*, CAV. An ornamental annual from Mexico, with smooth, erect, branched stem, 4° to 8° high, and leaves bipinnately divided into narrowly linear or almost filiform, entire, remote lobes. Heads with yellow disk and 8 pink or crimson rays, 1' or more in length, on long peduncles. Akenes smooth, with an abrupt, short beak, and 1 to 3, usually 3, short awns. Scales ovate-lanceolate. Many varieties are cultivated. Sept., Oct.

2. *C. tenuifolius*, LINDL. A smaller Mexican annual than the preceding, with more finely divided leaves, rich, purple rays, and a 1-awned pappus.

3. *C. sulphureus*, CAV. A pubescent, much-branched, Mexican annual, 3° to 7° high, with 2 to 3-pinnately cut leaves, 1° or more long, the lobes lanceolate and mucronate. Heads 2' to 3' wide, with 8 broadly obovate, 3-toothed rays, as well as the disk pale, pure, golden or orange yellow. Akenes linear, and with the slender beak 1' long. The original of all the yellow varieties of *Cosmos*.

4. *C. diversifolius*, OTTO. BLACK COSMOS. A tender, Mexican annual, 12' to 16' high, with slender, tuberous roots and the dwarf habit,

and early, dark red flowers of a *Dahlia*, and classed as such or as a *Bidens* by florists. Leaves pinnately parted, with 5 to 7 entire or slightly serrate segments, the terminal ones largest. Heads solitary, on peduncles 6' or more long, with dark velvety rays and red disk. Akenes linear, 4-angled, but *not distinctly beaked*, and the 2 rigid, persistent awns *not barbed*.

XXXI. GAILLARDIA, Foug. GAILLARDIA. BLANKET FLOWER. Annual or perennial, American herbs, with alternate or radical leaves, and large, showy, solitary, peduncled heads of yellow or purplish flowers terminating the branches or scapes. Disk flowers perfect, fertile, generally purple. Rays wedge-shaped, 3-toothed, neutral or rarely pistillate, yellow, purple, or parti-colored. Involucral scales in 2 or 3 rows; the outer larger, loose, and leaf-like. Receptacle convex or globose, naked, bristly, or fimbriate. Akenes top-shaped, mostly hairy. Pappus of 5 to 10 thin, long-awned scales.

1. *G. lanceolata*, Mx. SWEET GAILLARDIA. A pubescent, leafy-stemmed annual or perennial (?), 1° to 2° high, with long, slender branches, in dry woods and pine barrens from S.C. to Fla. west to southern Kan. and Tex. Leaves lanceolate, spatulate, or linear, 1' to 3' long, entire or toothed, sessile on the stem, the radical ones broader and sometimes petioled. Heads 1' to 2' wide, fragrant. Disk flowers dark purple or violet, with long, subulate teeth. Rays yellow or reddish, with dark veins, rarely none. Scales as long as the disk. Receptacle naked. Akenes hairy below. May to Sept.

2. *G. pulchella*, Foug. SHOWY GAILLARDIA. A soft-pubescent annual, 6' to 15' high, or taller in cultivation, branching from the base, with *rather soft*, lanceolate, oblong, or spatulate leaves, native in dry soils from Neb. and Mo. to La., and cultivated in gardens. Leaves 1' to 3' long, the upper entire, sessile; the lower incised or toothed, on short petioles. Heads 1' to 2' wide, on long peduncles. Disk flowers with subulate teeth. Rays 10 to 20, with yellow teeth and rose-purple base. Receptacle with fimbriae as long as the hairy or glabrous akenes. Var. *picta*, Gray, the common garden form, with larger heads and of various colors, sometimes has the rays tubular and the disk flowers enlarged. May to Sept.

3. *G. aristata*, Pursh. LARGE-FLOWERED GAILLARDIA. A perennial, with simple or slightly branched, more or less hairy stem, 1° to 3° high, native on prairies and plains from Minn. westward, and the common, cultivated *Gaillardia* of the gardens. It is similar to No. 2, often difficult to distinguish from it in cultivation, differing mainly in its *larger and yellower heads*, 3' to 4' wide, its *firmer leaves*, its *taller growth*, and in its being a perennial. May to Sept.

XXXII. HELENIUM, L. SNEEZEWEED. AMERICAN SNEEZE-WORT. Annual or perennial, North and Central American herbs, with alternate, simple, usually granular-dotted, often decurrent leaves, and solitary or corymbed, peduncled heads of yellow or brownish disk and ray flowers, the latter sometimes wanting. Disk flowers perfect, fertile. Rays pistillate and fertile or neutral, wedge-shaped, 3 to 5-toothed. Receptacle oblong,

globose or convex, naked. Scales in 2 rows, the outer narrow, leafy, spreading, the inner chaffy. Akenes top-shaped, ribbed. Pappus of 5 to 8 chaffy, acuminate, or awned scales.

Disk yellow.	Rays fertile.	Leaves lanceolate, toothed	.	.	.	.	No. 1
Disk yellow.	Rays fertile.	Leaves linear, entire	.	.	.	.	No. 2
Disk purple.	Rays neutral.	Leaves lanceolate	.	.	.	.	No. 3

1. *H. autumnale*, L. COMMON SNEEZEWEED. SWAMP SUNFLOWER. A perennial, with smooth or slightly pubescent, narrowly winged stem, 2° to 5° high, common in wet grounds and swamps from Me. to the Daks. south to Fla. and Tex. Leaves firm, bright green, lanceolate to ovate-oblong, toothed, 2' to 5' long, acute, narrowed to a sessile base, decurrent. Heads 1' to 2' wide, on slender peduncles, in loose corymbs, with globose, yellow disk, and 10 to 15 drooping, fertile, bright yellow, 3-cleft rays longer than the disk. Its leaves are very bitter; poisonous to cattle, and when dry and powdered produce sneezing. Called also *Yellow Star*, *False Sunflower*, etc. July to Oct.

2. *H. tenuifolium*, NUTT. FINE-LEAVED SNEEZEWEED. A very leafy, smooth or smoothish annual, 8' to 24' high, with slender stem, naked below, fastigiate branched above, and entire, linear-filiform leaves, 1' to 2' long, often fascicled, very common in wet ground from southern Va. to Mo. south to Fla. and Tex. Heads 9'' to 15'' wide, on long, slender peduncles. Rays 5 to 10, fertile, yellow, drooping, longer than the yellow disk. Aug. to Oct.

3. *H. nudiflorum*, NUTT. PURPLE-HEAD SNEEZEWEED. A perennial, with slender, pubescent, narrowly winged stem 1° to 3° high, branched near the top, found in moist soils from N.C. to Ill. and Mo. south to Fla. and Tex., and naturalized from the South in southeastern Pa. Leaves lanceolate to linear, acute, entire or nearly so, 1' to 3' long, decurrent; the lower and radical spatulate, obtuse, toothed. Heads 12'' to 18'' wide, short-peduncled. Disk brownish or purple, globose. Rays 10 to 15, or wanting, neutral, or with sterile pistils, yellow, with brown or purple base, or all brown or purple or all yellow, drooping, 3-toothed. June to Oct.

XXXIII. GALINSÔGA, RUIZ AND PAVON. Tropical American annuals, with thin, 3-ribbed, opposite leaves, and small axillary or terminal heads of yellow disk and white or purple ray flowers. Disk flowers perfect. Rays 4 or 5, very small, pistillate. Involucral scales ovate, thin, nearly equal, in 2 rows. Receptacle chaffy. Akenes 4 to 5-angled, top-shaped. Pappus of several oblong, lacerated, chaffy scales; sometimes wanting.

1. *G. parviflora*, CAV. A South American weed, with smoothish or pubescent stem, 1° to 3° high, naturalized in many countries of the Old World, as well as in dooryards and waste places in all parts of our area, and rapidly spreading from year to year. Leaves ovate or deltoid-ovate, acute, 1' to 3' long, somewhat toothed or entire; the upper sessile or short-petioled; the lower on slender petioles. Heads usually many. 2'' to 3'' wide. Disk yellow. Rays white or whitish. Pappus of 8 to 16 scales shorter than the akene. June to Nov.

XXXIV. ANTHEMIS, L. CAMOMILE. Strong-scented, branching, Old World herbs, with alternate, pinnately divided

leaves, and solitary terminal heads of disk and ray flowers. Disk flowers perfect, yellow. Rays pistillate and fertile, or neutral in No. 1, below, white, rarely yellow. Involucral scales imbricated, in several rows, appressed, with scarios margins, the outer shorter. Receptacle convex or conical, chaffy at the top. Akenes oblong, terete, ribbed or angled, glabrous. Pappus none, or a mere border or crown.

§ <i>MARÛTA</i> . Rays neutral, white	No. 1
§ <i>ANTHEMIS</i> , proper. Rays pistillate, white	Nos. 2, 3
Rays pistillate, yellow	No. 4

1. *A. Cótula*, L. (*MARÛTA COTULA*, DC.) **MAYWEED. FETID OR DOG'S CAMOMILE.** A smooth, ill-scented, acrid, cosmopolitan, annual weed, naturalized in fields and waste places and by roadsides throughout our area and around the globe to Asia, Africa, and Australia. Stem erect, much branched, 1° to 2° high. Leaves mostly sessile, 1' to 2' long, 1 to 3-pinnately dissected into linear-subulate lobes. Heads usually many, about 1' wide. Rays 10 to 18, white, neutral, or with imperfect pistil, finally reflexed. Chaff shorter than the flowers. Akenes 10-ribbed. Pappus none. June to Nov.

2. *A. arvënsis*, L. **CORN OR FIELD CAMOMILE.** A pubescent or whitish downy, inodorous, European annual or biennial weed, naturalized in fields and waste places from Me. to Mich. south to Va. and Mo. Stems erect or ascending, bushy, 8' to 15' high. Leaves sessile, 1' to 3' long, 1 to 2-pinnately parted into lanceolate or linear-lanceolate segments. Rays pistillate, 10 to 15, white. Chaff lanceolate, pointed, longer than the flowers. Akenes 4-angled. Pappus a narrow rim. May to Aug.

3. *A. nobilis*, L. **COMMON OR GARDEN CAMOMILE.** An agreeably strong-scented, pubescent, downy or woolly, European perennial, with prostrate or erect, much-branched, leafy, furrowed stems, 6' to 18' high, long cultivated for the tonic and other medicinal properties of its flowers, and sparingly escaped from gardens from R.I. to Del. and Mich. Leaves finely dissected into linear-subulate segments. Rays 12 to 18, white, pistillate. Chaff obtuse, scarcely as long as the flowers. Akenes obtusely 3-angled. Pappus none. June to Aug.

4. *A. tinctoria*, L. **YELLOW OR OXEYE CAMOMILE. GOLDEN MARGUERITE.** A bushy, pubescent or woolly, European perennial, with angled stem, 1° to 3° high, cultivated for ornament, and somewhat escaped to fields and waste places from Me. to N.J. Leaves sessile, 1' to 3' long, pinnately divided into oblong, pinnately lobed, cut or toothed segments. Heads 12'' to 18'' wide. Rays 20 to 30, pistillate, yellow. Chaff lanceolate, acute. Akenes 4-angled. Pappus a crown-like rim. The plant yields a yellow dye, hence specific name (*tinctoria*, dyer's). June to Sept.

XXXV. ACHILLËA, L. Herbs, generally perennial, with erect stems, alternate, toothed, pinnatifid, or dissected leaves, and small heads of disk and ray flowers in terminal corymbs. Disk flowers perfect, usually yellow. Rays few, pistillate, fertile. Involucre obovoid or campanulate; scales imbricated, appressed, the outer shorter. Receptacle flat or flattish, chaffy. Akenes oblong, obcompressed. Pappus none.

1. *A. Millefolium*, L. YARROW. MILFOIL. A perennial, of a pungent odor, with smooth or pubescent, simple stems, 1° to 2° high, often branched at the top, common in fields, and pastures, and other places throughout most of the northern hemisphere, regarded as introduced from Europe in the eastern U.S., where the plants are smoother and greener than in the Western States. Leaves woolly, downy, or nearly glabrous, narrowly oblong or lanceolate in outline, bipinnately parted, with crowded, 3 to 6-cleft, linear segments; radical ones usually petioled, stem ones sessile. Heads small, 2" to 3" wide, in dense, flat-topped corymbs. Involucre oblong. Rays 4 to 5, short, white, sometimes pink. July to Oct.

XXXVI. CHRYSÁNTHÉMUM, L. Herbs or somewhat shrubby plants, with alternate, toothed, pinnatifid, or dissected leaves, and solitary or corymbed heads of disk and ray flowers, the latter rarely wanting. Disk flowers perfect, fertile, mostly with flattened tube, usually yellow. Rays pistillate, fertile, many, generally white. Involucral scales imbricated, appressed, with scarious margins. Receptacle flat or convex, naked, except in some double-flowered forms. Akenes angled or terete. Pappus none or cup-shaped.

Leaves toothed	No. 1
Leaves lobed, but not pinnatifid	Nos. 2, 3
Leaves pinnatifid or pinnatisect	Nos. 4, 5, 6, 7

1. *C. Leucanthemum*, L. (*LEUCANTHEMUM VULGARE*, LAM.) OXEYE DAISY. WHITEWEED. A smooth, European perennial, with simple or sparingly branched stem, 1° to 2° high, from a creeping rootstock, exceedingly common as a weed in pastures, meadows, and waste places throughout our area. Stem leaves spatulate, the upper gradually narrower, small, and linear, pinnately dentate or cut, partly clasping; radical ones broader and petioled. Heads solitary, broad, flat, 1' to 2' wide, on long, naked peduncles. Disk yellow. Rays many, white. May to Nov.

2. *C. Sinense*, SABINE. (*C. MORIFOLIUM*, RAMATUELLE.) CHINESE CHRYSANTHEMUM. A more or less woolly perennial from China and Japan, 2° to 4° high, with *variable* leaves, but usually *thick, firm, leathery, glaucous beneath*, long-petioled, ovate in outline, sinuately lobed and cut (*morifolium*, mulberry-leaved). *Heads large, with very long, never yellow (?) rays. Receptacle with chaff on the disk.* The parent, with the next, of the common garden *chrysanthemums*. Varieties, with double and quilled flowers of many colors, occur in cultivation.

3. *C. Japónicum*, THUNB. (*C. INDICUM*, L.) JAPANESE CHRYSANTHEMUM. A smaller perennial than No. 2, from China and Japan (not found wild in India, as implied in the Linnæan specific name given above), with thinner and more sharply cut leaves, not glaucous, but green on both sides. *No chaff on the disk.* Flowers smaller, more numerous, and the *rays always yellow and short*, little longer than the involucre. Cultivated in many varieties, and hybridized with No. 2.

4. *C. Parthenium*, PERS. FEVERFEW. FEATHERFEW. A smooth, European perennial, common in old gardens, and somewhat escaped, with stout, grooved or striate, leafy, branching stems, 1° to 3° high, and thin, ovate leaves bipinnately divided into ovate, cut segments; the lower often 6' long and petioled; the upper sessile. Heads many, 8" to 10" wide, corymbed, on slender peduncles. Rays 10 to 20, oval or obovate, white, generally toothed; usually double-flowered. Pappus a toothed crown. Called also *Wild Camomile*, etc. Summer.

5. *C. coronarium*, L. SUMMER CHRYSANTHEMUM. A smooth, garden annual from the Mediterranean region, with spreading stems, 8" to 4' high, bipinnately parted, somewhat clasping or auriculate leaves, the segments lanceolate or linear. Heads with yellow, lemon-colored, or whitish rays, usually double, with rays imbricated and reflexed. July to Sept.

6. *C. carinatum*, WILLD. (*C. tricolor*, AND.) The gaudiest and probably the commonest of the annual chrysanthemums, a smooth plant, with much branched stem, about 2' high, from Morocco. Leaves fleshy, bipinnate. Heads 2' to 3' wide, with dark purple disk, white rays, and a yellow ring at their base, whence one specific name (*tricolor*). Involucral scales keeled (*carinatum*). Many varieties occur, of which Var. *Burridgeanum*, has a fourth color in a ring of red on the rays. July to Oct.

7. *C. frutescens*, L. MARGUERITE. PARIS DAISY. A bushy, erect, greenhouse perennial, 2' to 3' high, from the Canaries, usually smooth and somewhat glaucous, with a shrubby (*frutescens*) base. Leaves green, fleshy, bipinnatifid, with linear segments. Disk yellow. Rays white, varying to lemon-colored. Heads numerous, 1' to 3' wide, on long, naked peduncles. Flowers throughout the year, but specially cultivated. Winter blooming.

XXXVII. TANACETUM, L. TANSY. Strong-scented, annual or perennial herbs, with alternate, variously dissected or toothed leaves, and small heads of yellow, tubular flowers, all alike and perfect, or only the central perfect, and the marginal ones pistillate and sometimes with short rays. Involucral scales imbricated, in several rows. Receptacle convex or flat, naked. Akenes angled or ribbed, with a flat top. Pappus a short crown or none.

1. *T. vulgare*, L. COMMON TANSY. A smooth or slightly pubescent, European perennial, with stout, erect, leafy, clustered, simple, annual stems 2' to 3' high, common in old gardens, and escaped to roadsides and fields from Me. to Minn. south to N.C. and Mo. Leaves pinnately divided into linear-lanceolate, pinnately cut or serrate segments. Heads flattish, 3" to 5" wide, usually many, on short peduncles, in dense, flat-topped corymbs. *Marginal florets terete, pistillate*, with short, oblique, 3-toothed limb. Akenes 5-ribbed. Pappus a 5-lobed crown. Var. *crispum*, with leaves more cut and crisped, sometimes called *Double Tansy*, cultivated for ornament in rockeries and as a garnish in cookery, is also found escaped like the type. The aromatic and bitter leaves are in some repute for tonic, stimulant, and other medicinal properties, and were formerly used for flavoring in cooking. July to Sept.

XXXVIII. ARTEMISIA. WORMWOOD. SAGEBRUSH. Bitter, aromatic herbs and low shrubs, with alternate leaves and nodding or erect, discoid heads of yellow, yellowish, greenish, or purplish flowers, usually in paniced spikes or racemes. Heads heterogamous, with marginal flowers pistillate and fertile, and central ones perfect and fertile or sterile; or homogamous, with all the flowers perfect and fertile. Involucre imbricated, with dry scales. Receptacle without chaff, and smooth or hairy. Akenes obovoid, without pappus.

Receptacle hairy. Florets all fertile. Heads heterogamous	Nos. 1, 2
Receptacle smooth. Florets all fertile. Heads heterogamous	Nos. 3, 4
Receptacle smooth. Florets all fertile. Heads homogamous	No. 5

1. *A. Absinthium*, L. COMMON WORMWOOD. ABSINTH. A shrubby, silky-hoary, European perennial, 2° to 3° high, with branching stem and 2 to 3-pinnately parted leaves, common in gardens and escaped to roadsides and waste places from Me. to Mass. and N.Y. Leaf lobes lanceolate to oblong or obovate and obtuse. Lower leaves on long petioles; upper on short ones or sessile; uppermost usually linear and entire. Heads hemispheric, yellow, many, drooping, short-peduncled, 2'' to 3'' wide, in leafy panicles. Florets all fertile, the marginal pistillate. Receptacle hairy. Used in domestic medicine as a vermifuge and one of the chief sources of the intoxicant, absinth. July to Oct.

2. *A. frigida*, WILLD. WORMWOOD SAGE. PASTURE SAGEBRUSH. A silky-hoary, perennial herb, with slightly woody base, and tufted, simple or branching stems, 6' to 20' high, growing on dry hills and plains and in rocky soils from Minn. to Tex. and westward. Leaves mostly 2-ternately or quinate divided, or parted into crowded, linear segments. Heads globular, 2'' wide, yellow, nodding, on short peduncles, in paniced racemes. Receptacle hairy. July, Aug.

3. *A. vulgâris*, L. COMMON MUGWORT. An erect, paniculately branched, Old World herb, with furrowed stem, 2° to 8° high, escaped from gardens to waste places from Me. to Mich. south to N.J. and Pa. Leaves white-cottony beneath, dark green and smooth above, 1' to 4' long, pinnately cleft into spatulate, oblong or lanceolate, acute or obtuse, cut-toothed or entire lobes; floral leaves linear-lanceolate, entire. Heads many, yellow, erect, ovoid, about 2'' wide, subsessile, in paniced, simple, or compound racemes or spikes. Receptacle smooth. July to Oct.

4. *A. Abrótanum*, L. SOUTHERNWOOD. OLD MAN. A shrubby, European perennial, cultivated in old gardens for its fragrant foliage, and escaped to waste places from Mass. to western N.Y. Stem smooth or somewhat pubescent, 2° to 4° high, with short, erect, or ascending branches. Leaves 1' to 3' long, 1 to 3-pinnately divided into linear, entire, nearly filiform segments; the uppermost linear; the lowest petioled. Heads many, 2'' to 3'' wide, yellowish, nodding, with downy, hemispheric involucre in a long, open panicle. Receptacle smooth. Old-English names *Lad's Love*, *Boy's Love*, etc. Aug. to Oct.

5. *A. tridentata*, NUTT. COMMON SAGEBUSH OR SAGEBRUSH. A hoary shrub, 1° to 12° high, with narrowly wedge-shaped leaves, 3 to 7-toothed at the truncate apex, and the *central and marginal flowers of the densely paniced heads all perfect and fertile*, is the immensely abundant and characteristic *sagebush* or *sagewood* of the great Western plains, but is not strictly within our area. July to Sept.

XXXIX. GNAPHALIUM, L. CUDWEED. EVERLASTING.

Woolly herbs, with alternate, entire, mostly sessile or decurrent leaves, and variously disposed discoid heads of yellowish or whitish pistillate and perfect flowers. Flowers all fertile; central ones few, perfect, with 5-toothed corollas; outer ones pistillate, with corollas very slender, 3 to 4-toothed. Receptacle usually flat, naked. Involucral scales imbricated, dry, scarious, white or colored. Akenes terete or flattish. Pappus a single row of rough, hair-like bristles.

§ Bristles of pappus distinct at base; falling off separately.

Plants tall, erect, with sessile leaves No. 1

Plants tall, erect, with decurrent leaves No. 2

Plants low, diffuse, with sessile leaves No. 3

§ Bristles of pappus cohering at base; falling off together No. 4

1. *G. polycéphalum*, Mx. COMMON EVERLASTING OR CUDWEED. A fragrant, erect, woolly annual, 1° to 2° high, common in dry fields and open places throughout our area. Leaves sessile, *not decurrent*, linear-lanceolate, acute, or the lower ones obtuse, 1' to 3' long, tapering to the base, with undulate margins, white-woolly beneath, as also the stem, smoothish and green above. Heads ovate, conical, at first becoming obovate, in numerous, corymbed, panicked clusters. Scales whitish, oblong, obtuse. Akenes smooth. Aug., Sept.

2. *G. decúrrens*, Ives. CLAMMY OR WINGED EVERLASTING OR CUDWEED. A clammy-pubescent, hoary annual or biennial, with stout, erect, very leafy stem, 2° to 3° high, corymbously branched above, found in open places from Me. to Minn. south to N.J. and Pa. Leaves linear-lanceolate or broadly linear, 1' to 3' long, partly clasping and decurrent, white-woolly beneath, rather naked above. Heads in dense, roundish, corymbed clusters. Corollas yellow. Scales ovate, acutish, yellowish-white. July to Sept.

3. *G. uliginosum*, L. LOW OR MARSH CUDWEED. An appressed-woolly, European annual, with spreading, diffusely branched, or sometimes erect or ascending stems, 3' to 6' high, naturalized in damp or wet places from Me. to Minn. south to Va. and Ind. Leaves many, sessile, spatulate, oblanceolate, lanceolate, or linear, 12' to 18'' long. Heads many, in dense, terminal, leafy-bracted clusters. Scales obtuse, brown. July to Sept.

4. *G. purpureum*, L. PURPLISH CUDWEED. A white-woolly annual, with simple and erect stem or with ascending branches from the base, 6' to 18' high, common in dry, sandy soil and in cultivated ground from Me. to Fla. westward to Pa., W. Va., Ky., Ark., and Tex. Leaves linear-spatulate or obovate-spatulate, obtuse, 1' to 2' long, green above, woolly beneath. Heads in sessile, axillary clusters, or in a slender, terminal, sometimes leafy spike. Scales acuminate, tawny or purplish. Corollas yellow. Bristles of pappus cohering at the base and falling off together. April to June.

XL. ANTENNÀRIA, Br. EVERLASTING. Perennial, mostly low, woolly herbs, with alternate, entire leaves, and small, dicecious, discoid, mostly corymbed heads of flowers. Pistillate corollas slender. Pappus a single row of bristles, scanty, and club-shaped or barbellate (antenna-like) in the sterile flowers, but copious, capillary, cohering at base, and falling off together in the fertile. In No. 2, however, none of the bristles are either club-shaped or coherent at base. Receptacle convex or flattish, without chaff, alveolate. Involucral scales imbricated, white or colored, dry, scarious.

1. *A. plantaginifolia*, Br. PLANTAIN-LEAF OR MOUSE-EAR EVERLASTING. A low, whitish-downy herb, common throughout our area in dry soils and open woods, blooming in early spring and spreading by offsets and runners into broad patches. Stem simple, 3' to 12' high. Leaves green and smoothish above, hoary beneath; chiefly radical, obovate or broadly oval, obtuse, 1' to 3' long, 8-ribbed, petiolate (plantain-leaved); stem ones

lanceolate, sessile; upper small and distant. Heads in a dense, terminal cluster. Called also *Early* or *Spring Everlasting*. Mar. to May.

2. *A. margaritacea*, BR. (*ANÁPHALIS MARGARITACEA*, BENTH. AND HOOK.) *PEARLY EVERLASTING*. A tall, whitish-downy herb, with erect, leafy, simple stem, 1° to 2° high, corymbously branching at the top and usually growing in tufts. Leaves linear-lanceolate, acute, sessile, narrowing to the base, 3' to 5' long, revolute, woolly beneath, green above. Heads very many, handsome, hemispherical, 4" wide when expanded, in a large, compound corymb. Flowers yellow, turning dark. Scales pearl-white (*margaritacea*), not withering. July to Sept.

XLI. ERECHTITES, RAF. Coarse, homely, erect annuals, with alternate, simple leaves, and corymbed or paniced, discoid heads of whitish or dull yellow flowers, all fertile, the central perfect, the outer pistillate and filiform. Involucre cylindrical, with swollen base. Scales linear, in 1 row, with several bractlets at the base. Receptacle naked. Akenes oblong. Pappus copious, of fine, soft, smooth, white hairs.

1. *E. hieracifolius*, RAF. *FIREWEED*. A smooth or sometimes hairy, rank-smelling herb, common throughout our area in fields and waste places, especially clearings that have been burned over, whence its common name. Stem erect, thick, fleshy, striate or grooved, usually branching, 1° to 6° high. Leaves thin, light green, oblong or lanceolate, acute, 2' to 8' long, unequally, often deeply toothed, sessile, the upper with auricled base. Heads 5" to 10" long by 2" to 3" wide, in a terminal, corymbous panicle. Flowers many, dull white. Involucre with tumid base before flowering. Pappus very soft and bright white. July to Sept.

XLII. CACALIA, L. Tall, perennial, generally smooth herbs, with alternate, usually petioled leaves, and corymbed, discoid heads of mostly white or whitish, perfect flowers. Involucre cylindric, with erect, linear scales in 1 row, often with a few bractlets at the base. Receptacle not chaffy. Akenes oblong, smooth. Pappus of rough, capillary bristles.

1. *C. reniformis*, MUHL. *GREAT INDIAN PLANTAIN*. A tall, smooth herb, with *grooved, angled*, nearly simple stem, 4° to 9° high, in rich, damp woods from N.J. and Pa. to Ill. and Minn. and south along the mts. to N.C. and Tenn. Leaves thin, *green both sides*, palmately veined, petioled, repand-toothed and angled; the lowest and radical reniform, 1° to 2° wide, on long petioles; middle and upper fan-shaped to ovate. Heads 5-flowered, many, in compound corymbs. Scales 5, with bractlets. July to Sept.

2. *C. atriplicifolia*, L. *PALE INDIAN PLANTAIN*. A perennial, with *terete, glaucous stem*, 3° to 6° high, found in rich woodlands from western N.Y. to Minn. south to Fla., Mo., and Kan. Leaves thin, *glaucous beneath*, palmately veined and angularly lobed; lower triangular-kidney-shaped or subcordate; upper fan-shaped or triangular, toothed. Flowers and involucre as in No. 1. July to Sept.

XLIII. EMÍLIA. Asiatic and African, smooth or hairy, annual or perennial herbs, sometimes included in *Cacalia*, differ-

ing mainly in being mostly annuals and in having red, orange, or yellow flowers, and 5-angled akenes with ciliate angles.

1. *E. flammæa*, Cass. TASSEL FLOWER. FLORA'S PAINT BRUSH. A smooth or slightly hairy, erect annual, 1° to 2° high, from East India and the Philippines, common in gardens under various botanical names, as *E. sagittata*, DC., *Cacalia coccinea*, Sims, etc. Radical leaves petio- late, obovate or spatulate, entire or toothed; stem ones oblong or ovate- lanceolate, crenate, more or less clasping. Heads in terminal clusters, with bright scarlet or golden-yellow flowers much longer than the ovate- cylindric involucre. Scales at length reflexed. June to Sept.

XLIV. SENECIO, L. Annual or perennial herbs, or in tropical regions sometimes shrubs or small trees, with alter- nate or radical, entire, pinnatifid or variously toothed or lobed leaves, and corymbed, paniced, or solitary heads of mostly yellow disk and ray flowers, all fertile, the former perfect, the latter pistillate or wanting. Involucre cylindric or bell-shaped. Scales linear, erect, equal, in 1 row, sometimes with a few bractlets at the base. Receptacle flat, not chaffy. Pappus of many, very slender, soft, capillary bristles. An immense genus, probably the largest of the vegetable kingdom, embracing from 1000 to 1200 species of wide distribution.

Heads discoid.	Erect annuals.	Naturalized	.	.	.	.	.	.	No. 1
Heads discoid.	Climbing perennials.	Greenhouse exotie	.	.	.	.	.	.	No. 2
Heads radiate.	Native plants	.	.	.	.	.	.	.	Nos. 3, 4, 5
Heads radiate.	Exotics.	Flowers all yellow	.	.	.	.	.	.	Nos. 6, 7
Heads radiate.	Exotic.	Rays purple, varying to white	.	.	.	.	.	.	Nos. 8, 9

1. *S. vulgaris*, L. GROUNDSEL. A smooth or smoothish, European annual, with erect, angular, hollow, branching stem, 6' to 18' high, and bright green, oblong or spatulate, sinuate-pinnatifid, toothed leaves, naturalized as a common weed in cultivated grounds and waste places from Me. to Minn. south to Va. Lower leaves petioled, upper ones sessile. Heads about 3" wide and 5" high, few or many, in terminal corymbs, *without rays*. Flowers yellow. Involucral scales often tipped with black, and usually with awl-shaped bractlets at the base. Akenes somewhat canescent. Pappus white. April to Oct.

2. *S. scandens*, DC. (*S. MIKANTOIDES*, OTTO.) GERMAN IVY. A smooth, slender, tall-twining perennial from South Africa, common in greenhouses. Leaves very smooth, soft, tender in texture, deltoid-ovate in outline, 5 to 7-angled, or angular-lobed. Heads small, in close clusters on terminal or axillary branches, *without rays*, and with 6 to 12 yellow disk flowers.

3. *S. aureus*, L. GOLDEN RAGWORT. SQUAWWEED. A bright green, smooth perennial, with solitary or tufted, slender, simple stems, 1° to 2° high, with golden-yellow flowers, common in low or wet grounds through- out our area and very variable. Radical leaves roundish, with cordate or truncate base (varying to ovate, oblong, obovate, or even lanceolate), crenate-dentate, 1' to 3' wide, on long, slender petioles; lower stem ones oblong or lanceolate, lyrate-ly divided or lobed; upper ones small, sessile, or somewhat clasping. Heads about 9" wide and half as high, on slender peduncles in a loose, open corymb. Rays 8 to 12. Akenes smooth. Pappus white. May to July.

4. *S. tomentosus*, Mx. WOOLLY RAGWORT. A woolly perennial, with stout, solitary or tufted stems, 1° to 2° high, in moist ground from N.J. to Fla. and La. Radical and lower leaves erect, oblong, or ovate-lanceolate, obtuse, 3' to 6' long, crenate or entire, with narrow or truncate base, on long petioles; upper ones sessile, smaller, few, distant. Heads 8" to 10" wide, on long peduncles, in a simple, subumbellate corymb. Rays 12 to 15. Akenes minutely hispid on the angles. April to June.

5. *S. lobatus*, Pers. BUTTERWEED. A very smooth, fleshy annual, with furrowed, hollow stem, 2° to 3° high, common in low, wet grounds and river bottoms from N.C. to Mo. south to Fla. and La. Leaves tender, 4' to 6' long, pinnately divided into oblong, obovate or cuneate, obtuse, toothed lobes, the terminal one usually largest. Heads 7" to 10" wide, on slender peduncles in a naked corymb. Rays 10 to 12, conspicuous. Akenes minutely hispid. April to July.

6. *S. Cineraria*, DC. (*CINERARIA MARITIMA*, L.) DUSTY MILLER. An old-fashioned garden perennial from the Mediterranean coast, 1° to 2° high, branching from the slightly woody base, ashy-white (*Cineraria*), woolly throughout. Leaves pinnately parted, with oblong, obtuse, sinuately lobed segments. Heads small, yellow, in small, dense corymbs. Several varieties. July to Sept.

7. *S. Kämpferi*, DC. (*FARFUGIUM GRANDE*, LINDL.) A greenhouse plant from Japan, cultivated mainly for its foliage, with a perennial rootstock sending up thick, fleshy, woolly, flowering stems, 1° to 2° high, with small, bract-like leaves, and light yellow, radiate heads, 18" to 24" wide. Radical leaves numerous, on slender, woolly petioles, large, 6' to 10' wide, orbicular-cordate, somewhat angled, thick, fleshy, dark green, smooth, shining, and in Var. *aureo-maculatus*, the LEOPARD PLANT, irregularly blotched with yellow or sometimes with white and rose. Seldom flowers in green-houses.

8. *S. cruentus*, DC. COMMON CINERARIA. A short-stemmed, greenhouse, herbaceous perennial from the Canaries, with many, corymbed, radiate heads of showy, purple, crimson, blue, white, or parti-colored flowers. Radical and lower leaves large, cordate-ovate to cordate-triangular, more or less lobed or angled, green above, with purple or crimson veins beneath, on margined petioles; upper ones sessile, ovate, auricled at base. The accredited parent of the various *Cinerarias* of the florists.

9. *S. elegans*, L. PURPLE RAGWORT. PURPLE JACOBÆA. A viscid-pubescent, half-hardy annual or biennial from South Africa, with varying leaves, and showy, yellow disk and purple ray flowers in loosely corymbed heads on long, scaly peduncles. Leaves usually oblong, pinnately divided into oblong, and sometimes sinuately toothed lobes, with broad, round sinuses; lower ones petioled; upper half clasping. Involucre with many, fringed, black-tipped bractlets at the base. Varieties occur with purple disk, with white rays, or double with the disk turned to rays.

XLV. TAGÈTES, L. Strong-scented, tropical American, mostly annual herbs, with usually opposite and pinnately divided or sometimes merely serrate leaves, and yellow, orange, or reddish flowers in discoid heads. Disk flowers perfect. Rays pistillate, mostly 5. Involucre cylindric or bell-shaped, of 5 to 10 united scales. Receptacle flat, naked. Akenes compressed or angled. Pappus of 3 to 6 chaffy scales or awns.

1. *T. pátula*, L. FRENCH MARIGOLD. A hardy, Mexican annual, in spite of its common name, cultivated extensively in gardens. Stem 12' to 18' high, with widely spreading branches from near the base. Leaves

pinnately divided into linear-lanceolate, serrate segments. Heads solitary, on elongated, nearly cylindric peduncles. Rays orange-yellow, marked with red or purple, but varying greatly from pure yellow to pure red. Heads often double. Involucre smooth. Aug.

2. *T. erecta*, L. AFRICAN MARIGOLD. A hardy garden annual of the same nativity as the preceding, notwithstanding its common name, and the more common species in our American gardens. Stem stout, erect, branched, 18' to 24' high. *Leaves pinnately divided into lanceolate, serrate segments.* Heads solitary, on shorter peduncles than in No. 1, and thickened at the top with heads twice as large. Flowers lemon-yellow, but varying from light yellow to deep orange. Involucre angular. Many varieties. July.

3. *T. signata*, BARTL. STRIPED MEXICAN MARIGOLD. A branching, Mexican annual, 12' to 18' high, with *pinnately divided leaves of usually 6 pairs of oblong-linear, deeply serrated segments, the lower serratures awned.* Flower heads small, yellow, solitary, on slender peduncles, with oblong-ovate, 5-angled involucre, and 5 obovate rays. The horticultural Var. *pumila*, small, bushy, 8' to 10' high, is the usual form in cultivation. July, Aug.

4. *T. lûcida*, CAV. SWEET-SCENTED MARIGOLD. A tender perennial from Chile, with erect, scarcely branched stem, 1° high, and sessile, lanceolate, sharply serrate leaves, awned on the lower teeth. *Flower heads yellow, fragrant, in dense, terminal corymbs.* Involucre cylindric. Rays 2 to 4. Aug.

XLVI. CALÊNDULA, L. Annual or perennial, Old World herbs, with alternate, simple leaves, and usually large, solitary, terminal heads of yellow or orange flowers. Disk flowers staminate, sterile. Rays pistillate, fertile, in 2 or more rows. Involucre of many, equal, leafy scales, in about 2 rows. Receptacle flat, naked. Akenes strongly incurved. Pappus none.

1. *C. officinâlis*, L. COMMON MARIGOLD. POT MARIGOLD. A hardy, more or less hairy annual from southern Europe, the *Marigold* of Shakespeare's time and of English literature generally, very common in country gardens, mostly for ornament in U.S., but in England also for the dried flowers used in flavoring soups and stews, whence the name *Pot Marigold*. Stem branching, 1° to 2° high. Leaves fleshy, disagreeable in odor, sessile, or clasping, oblong, acute, mucronate, with subdentate and rough-fringed margin. Heads produced all summer, on stout stalks, with usually orange flowers, the rays in several rows, and closing at night. Akenes boat-shaped, mucronate, keeled. Varieties occur in all shades of yellow and orange, and in various degrees of doubling. June to Sept.

XLVII. CENTAÛREA, L. Annual or perennial, herbaceous or half-shrubby plants, with alternate, entire to pinnatifid or bipinnatifid leaves, and solitary, discoid heads of flowers ranging from white to purple, all tubular and perfect, with equally or obliquely 5-cleft corollas, or the marginal ones much enlarged and neutral. Involucre globose or ovoid; *scales imbricated, in several rows, appressed, usually with fringed, toothed, or otherwise appendaged tips.* Receptacle flat or convex, bristly. Akenes

obovoid or oblong, obliquely attached at the base. Pappus bristly, chaff-like, or wanting.

A very large genus in the Old World, 800 to 400 species, only 3 or 4 being indigenous to the New, and but one of these North American, No. 1 below.

Involucral scales with a pectinately fringed appendage	Nos. 1, 2
Involucral scales merely laciniate or toothed	No. 3
Involucral scales armed with spines	No. 4
Involucral scales without fringe, teeth, or spines	Nos. 5, 6

1. *C. Americana*, NUTT. BASKET FLOWER. NORTH AMERICAN CENTAUREA. A hardy, nearly smooth annual, with stout, erect, grooved, simple or sparingly branched stem, 2° to 4° high, found on dry plains from Mo. to La. and westward, and cultivated for ornament. Leaves smooth, lanceolate and acute to oblanceolate or spatulate, 2' to 5' long, entire or nearly so, mostly sessile. Heads 2' to 4' wide, solitary or few, on the thickened, naked stem or branches. *Flowers pink or pale purple, the outer ones enlarged, the lobes sometimes 1' long, neutral. Scales with conspicuous, straw-colored, pectinate-ciliate appendages.* Akenes compressed. Pappus of many unequal bristles longer than the akene. May to Aug.

2. *C. nigra*, L. Knapweed. HARDHEADS. A rough, pubescent, European, perennial herb, with stiff, erect, branched stem, 1° to 2° high, naturalized in pastures and waste places from Me. to N.J. Leaves rough, lanceolate to oblong or spatulate, acute, entire to dentate or angularly-lyrate, 3' to 6' long, upper ones sessile. Heads few, less than 1' wide, or leafy stalks. *Scales tipped with conspicuous, dark brown or blackish, pectinate-ciliate appendages.* Flowers rose-purple, all perfect and alike. Akenes somewhat 4-angled. Pappus none, or very short scales. July to Sept.

3. *C. Cyanus*, L. BLUEBOTTLE. CORNFLOWER. BACHELOR'S BUTTON. A hardy, downy or woolly, silvery, whitish-green, European annual, with erect, slender stem, 1° to 2° high, slender, erect branches, and linear, mostly entire leaves, cultivated extensively in gardens and escaped to roadsides and other waste places from New Eng. to western N.Y. south to Va. Leaves 3' to 6' long, lower and radical dentate or sometimes pinnatifid. Heads 12" to 18" wide, on long, naked stalks. Flowers blue or purple, varying to pink and white; *outer ones much enlarged and neutral.* Involucre ovoid. Scales greenish, fringed with short, scarious teeth. Blooms until frost, and grows again in spring from the fallen seeds. July to Sept.

4. *C. Calcitrapa*, L. STAR THISTLE. A green, hairy, pubescent or smooth European annual, with diffusely branched stem, 12' to 18' high, naturalized in waste places from southern N.Y. to N.C. Leaves oblong-lanceolate, pinnately lobed, with linear, toothed segments, lowest ones petioled, 4' to 7' long, upper sessile, uppermost simply toothed and involucre beneath the sessile heads. Flowers purple, all alike, in heads about 1' wide. Involucre ovoid. *Principal scales tipped with strong, spreading spines, which have usually 1 or more minute spines at the base, but are sometimes simple.* Pappus none.

5. *C. moschata*, L. SWEET SULTAN. A smooth, bright green annual from Persia, with erect stems, about 2° high, branching below, lyrate-dentate leaves, and long-peduncled heads of *musk-scented* (moschata) purple, varying to rose and white flowers, the outer ones scarcely enlarged. Involucre roundish or ovoid, smooth. Scales ovate, without spines, teeth, or fringe. Pappus none. July to Oct.

6. *C. suaveolens*, L. YELLOW SWEET-SULTAN. A hardy annual from the Levant, about 18' high, similar to No. 5, and possibly a mere variety as regarded by some, but with the lower leaves broad and some-

what spatulate and toothed, the upper lyrate at base, and the *heads of sweet-scented, yellow flowers, the outer ones much enlarged.* Involucre round, smooth. Pappus chaff-like. July to Sept.

XLVIII. CNICUS, Tourn. THISTLE. Stout herbs, of the northern hemisphere, mostly biennial, with alternate, sessile, or radical, usually very prickly leaves, and large or medium-sized, discoid heads of red, purple, or rose-colored, rarely white or yellowish, perfect and fertile, or rarely imperfectly diœcious flowers. Involucre ovoid or subglobose; scales imbricated, in many rows, prickly tipped or unarmed. Receptacle flat or convex, bristly or hairy. Akenes oblong, smooth, flattish. Pappus copious, plumose.

- a. Involucral scales all with spreading, prickly tips No. 1
- a. Involucral scales mostly without spreading, prickly tips. (b)
 - b. Leaves green above, white-woolly beneath Nos. 2, 3, 4
 - b. Leaves green on both sides, or only slightly white-woolly beneath. (c)
 - c. Heads large, with 10 to 30 leafy bracts beneath. Flowers yellow . . . No. 5
 - c. Heads large, with or without 1 to 5 leafy bracts beneath. Fla. fragrant . . . No. 6
 - c. Heads rather large, glutinous, cobwebby. Plants tall No. 7
 - c. Heads small. Plants low, 1° to 2° high No. 8

1. C. lanceolatus, Willd. COMMON THISTLE. BULL OR SPEAR THISTLE. An Old World biennial, naturalized from Europe as a common weed in pastures, roadsides, etc., from Me. to Minn. south to Ga., Neb., and Mo. Stem rather stout, branched, 3° to 5° high, leafy, tomentose. *Leaves decurrent*, dark green, rough-bristly above, woolly beneath, lanceolate, acuminate, 3' to 6' long, pinnatifid, with prickly, divaricate segments. Heads several, solitary, terminal, 18" to 24" wide and high. Involucre ovoid. Flowers purple. Scales lanceolate, cottony, each tipped with a slender, erect, ascending or spreading spine. July to Sept.

2. C. altissimus, Willd. TALL THISTLE. A biennial or perennial, with slender, leafy, downy or hairy, branching stem, 3° to 10° high, common in fields, copses, and thickets from Mass. to Minn. south to Fla. and Tex. Leaves green, sparingly pubescent above, white-woolly beneath, lanceolate-oblong, 5' to 8' long, with margins varying from merely spinulose-ciliate, slightly toothed, to lacinate-cleft or sinuate, or in the lower ones deeply sinuate-pinnatifid and weakly prickly, uppermost ones linear or lanceolate and smaller. Heads 18" to 24". Outer scales ovate-lanceolate, tipped with a spreading, bristle-like prickle, inner ones narrower, unarmed. Flowers light purple. Aug., Sept.

3. C. discolor, Muhl. FIELD THISTLE. A plant similar to No. 2, but lower, seldom exceeding 5°, and with nearly all the leaves deeply pinnatifid into linear or lanceolate, prickly, toothed lobes, common in borders of fields and thickets, and along roadsides from Me. to Minn. south to Ga., Neb., and Mo. Outer involucral scales tipped with longer prickles than in No. 2. The flowers the same, or pink, or rarely white. July, Aug.

4. C. Virginianus, Pursh. VIRGINIA THISTLE. A biennial, of dry woods, thickets, and plains from Va. to Ohio south to Fla. and Tex., with slender, woolly stem, 1° to 3° high, simple or sparingly branched, the stem and branches ending in long, naked peduncles. Leaves green above, white-woolly beneath, lanceolate, prickly margined, entire, repandentate or sinuate-lobed. Heads small, flowers purple. Outer scales with short, weak, bristly tips. April to Sept.

5. *C. horridulus*, PURSH. **YELLOW THISTLE.** A biennial or perennial, with *stout*, leafy, branched stem, webby-haired or woolly when young, 1° to 3° high, in sandy soils near the coast from Me. to Pa., Fla., and Tex. Leaves green on both sides, somewhat clasping, lanceolate, pinnatifid, with acutely cut, short, toothed, spiny lobes. Heads 18" to 30" high, 2' to 3' wide, with a *whorl* of 10 to 20, *strongly prickly, linear or lanceolate leaves at the base*, and narrowly lanceolate, pointed, but not prickly scales. Flowers pale yellow or sometimes purple. May to Aug.

6. *C. pumilus*, TORR. (*C. odoratus*, MUHL.) **PASTURE THISTLE. FRAGRANT THISTLE.** A hairy biennial, with low, stout, striate, mostly simple stem, 1° to 2° high, with 1 to 3 very large, solitary, terminal heads of fragrant, purple, rarely white flowers, common in pastures, dry fields, and roadsides from Me. to Del. and western Md. Leaves green on both sides, clasping, or the radical ones petiolate, oblong-lanceolate, acute, 3' to 6' long, pinnatifid into short, irregularly cut, prickly toothed lobes. Heads 2' to 3' wide and high, often subtended by 1 to 5 leaf-like bracts. Involucre round-ovate. Outer scales prickly pointed. July to Sept.

7. *C. misticus*, PURSH. **SWAMP THISTLE.** A tall and handsome biennial thistle, with slender, striate, angled, smoothish stem, 3° to 8° high, branched above, common in swamps and moist soils throughout our area. Leaves green on both sides when mature, ovate-lanceolate, deeply pinnatifid, with lanceolate, acute, irregularly dentate lobes, the teeth tipped with slender, weak prickles; radical ones 6' to 8' long, petioled; stem ones sessile, smaller. Heads 1' wide and high, solitary, terminal on naked peduncles, with purple flowers. Involucre ovoid. *Scales unarmed, appressed, cobwebby, glutinous.* Aug., Sept.

8. *C. arvensis*, SCOP. **CANADA THISTLE. CREEPING THISTLE.** A European perennial, with slender, striate stems, 1° to 2° high, and long creeping rootstocks very tenacious of life, making it a very troublesome weed, naturalized in fields and waste places from Me. to Minn. and Neb. and south to Va. Leaves smoothish, green on both sides or somewhat woolly beneath, *wavy*, lanceolate, sinuate-pinnatifid, with prickly, lobed, or dentate divisions. Heads many, 4" to 5" wide, 8" to 10" high, corymbed, imperfectly diœcious. Flowers purple, projecting in the staminate heads, shorter in the pistillate, with the long pappus visible. Involucre ovoid or globous, with the outer ovate-lanceolate, appressed scales tipped with minute, prickly points. July.

XLIX. ÁRCTIUM, L. (LÁPPA, TOURN.) Coarse, rank, Old World biennials, with large, roundish leaves, and medium-sized, discoid heads of pink or white, perfect, and fertile flowers. Involucre globular; scales imbricated, slender-awl-shaped, with appressed base and erect or spreading, bristly, hooked tip. Receptacle bristly. Akenes oblong, somewhat flattened. Pappus of many, short, rough, deciduous bristles.

1. *A. Láppa*, L. **BURDOCK.** A European weed, naturalized and common in waste and cultivated grounds, and by roadsides throughout our area. Stem stout, 1° to 5° high. Leaves roundish, ovate or lanceolate, with cordate, rounded, or tapering base and usually sinuate-denticulate margin, green and smooth above, whitish with cottony down beneath. In the larger form, Var. *majus*, GRAY (*LAPPA MAJOR*, GAERT.), the bur, 1' in diameter, has the *scales all spreading and glabrous*. Var. *tomentosum*, GRAY (*LAPPA TOMENTOSUM*, LAM.), has the *scales densely woolly* and the *inner ones erect* and shorter than the flowers, is found mainly in the northeastern U.S., and is regarded by some as a distinct species,

Var. minus, GRAY (LAPPA MINOR, DC.), with smaller, only slightly woolly heads, and the inner scales erect, seems to be the most widely dispersed form, especially in the Southern States, and is also regarded by some as a distinct species. July, Aug.

L. CICHORIUM, L. Annual and perennial, Old World herbs, with stiff, branching stems, large, radical leaves, small, alternate, cauline ones, and showy, sessile or peduncled heads of ligulate, mostly blue flowers, varying to purple, pink, or white. Involucral scales in 2 rows; the outer, 4 to 6, shorter, spreading, or reflexed; the inner, 8 to 10, erect. Receptacle flat, naked, or slightly hairy. Akenes usually short, truncate, not beaked. Pappus a short crown of chaffy scales.

1. C. Intybus, L. CHICORY. SUCCORY. A European perennial, with a long, fleshy taproot, a rigid, channeled, slightly hairy, branched stem, 2° to 3° high, and clustered or solitary, mostly sessile heads of bright sky-blue flowers, naturalized along roadsides and in fields and waste places from New Eng. to Minn. and Neb. south to N.C. and Mo. Radical leaves spreading, lanceolate, runcinate, 3' to 6' long; stem ones much smaller, lobed or entire, auriculate and clasping; those on the branches reduced nearly to bracts. Heads 12" to 18" wide, usually in axillary clusters of 2 to 4. Flowers varying to purple or white, closing by noon.

Regarded generally in this country as a weed, but in Europe cultivated both for its root and its leaves; the former to be used as a substitute or adulterant for coffee or eaten as a vegetable; the latter to be used either as a salad or a pot herb. July to Oct.

II. KRIGIA, SCHREBER. DWARF DANDELION. Annual or perennial, North American herbs, with alternate or radical leaves and terminal heads of ligulate, yellow flowers on naked scapes or branches. Involucral scales narrow, equal, thin. Receptacle naked, flat. Akenes columnar or top-shaped, truncate, many-ribbed. Pappus double; the outer of thin, rounded, chaffy scales; the inner of slender bristles, rarely wanting in one Western species.

§ **KRIGIA** proper. Pappus of 5 scales and 5 to 10 bristles No. 1
§ **CYNTHIA.** Pappus of 10 to 15 scales and as many or more bristles Nos. 2, 3

1. K. Virginica, WILLD. A low annual, of dry soils throughout our area, with tufted radical leaves and several naked scapes, 2' to 10' high, bearing solitary heads, 3" to 7" wide, of 20 to 30 deep yellow flowers. Leaves 1' to 6' long, varying from obovate-spatulate to lanceolate or linear, and from few-toothed or entire to sinuate or pinnately lobed. Akenes top-shaped, striate, 5-angled. Pappus of 5 short, rounded scales and 5 to 10 long, slender, rough bristles. April to Aug.

2. K. amplexicaulis, NUTT. (CYNTHIA VIRGINICA, DON.) A smooth, glaucous perennial, of moist or dry soils from Mass. to Minn. south to Ga., Ky., Mo., and Kan., with fibrous roots, tufted radical leaves, 3' to 5' long, and a slender stem, 1° to 2° high, bearing 1 to 3 leaves and at the top 2 to 5 long-peduncled heads, about 18" wide, of 15 to 20 deep yellow or orange flowers. Leaves oblong or oval, obtuse, entire or repand, and denticulate; radical ones on winged petioles and often pinnatifid; stem

ones *amplexicaul* by a broad base. *Akenes columnar*. *Pappus* of 10 to 15 oblong scales and as many or more slender capillary bristles. May to July.

3. **K. Dandelion**, NUTT. (*CYNTHIA DANDELION*, DC.) A smooth, slightly glaucous perennial, of moist and low grounds from Md. to Kan. south to Fla. and Tex., with slender roots bearing one or more globular tubers, radical leaves 3 to 6' long, and several, simple, naked scapes 6' to 18' high, bearing solitary heads, about 1' wide, of 15 to 20 yellow flowers. Leaves spatulate-oblong to linear-lanceolate, entire or toothed, rarely pinnatifid. Akenes and pappus as in No. 2. April to June.

LII. LEONTODON, L. Low, stemless, Old World, perennial herbs, with tufted, radical, toothed or pinnatifid leaves, and large, solitary, terminal heads of ligulate, yellow flowers on simple and naked or branched and scaly scapes. Involucre oblong or ovoid; scales narrow, in several rows, the outermost very short. Receptacle naked. Akenes slender, tapering at the top. Pappus of persistent, feathery, brownish bristles, more or less widened at the base.

1. **L. autumnale**, L. FALL DANDELION. AUTUMNAL HAWKBIT. A European plant, naturalized in meadows and along roadsides from New Eng. to N.J., Pa., and Ohio, with short, premorse rootstock, smoothish, narrowly lanceolate, lacinate-dentate or pinnatifid, radical leaves, 3' to 8' long, and a slender, round, striate, hollow, usually branching scape, 6' to 20' high. Heads 1 to several, 12'' to 15'' wide, terminal on the stem or on the pedunculate, scaly-bracted branches. June to Nov.

LIII. HIERACIUM, L. HAWKWEED. Perennial, mostly European and South American herbs, usually hispid or hirsute, often glandular-hairy, with toothed or entire, alternate or radical leaves, and loosely paniced or corymbed, rarely solitary, small or medium-sized heads of ligulate, yellow or rarely orange flowers, a single species with white ones. Involucral scales more or less imbricated. Receptacle not chaffy. Akenes oblong or columnar, not beaked. Pappus a single row of tawny, rough, fragile, capillary bristles. Flowering in summer and early autumn.

Flowers yellow, 40 to 50 in a head	. . . . .	No. 1
Flowers yellow, 15 to 30 in a head. Akenes tapering at the top	. . . . .	No. 2
Flowers yellow, 15 to 30 in a head. Akenes not tapering at the top	. . . . .	Nos. 3, 4
Flowers orange or red	. . . . .	No. 5

1. **H. scabrum**, Mx. ROUGH HAWKWEED. A robust, rough-hairy plant, common in dry, open woods and clearings from Me. to Minn. and Neb. south to Ga. and Kan., with a round, striate, erect, leafy stem, 1' to 3' high, hispid below and *glandular-pubescent* above. Leaves hairy, oval or obovate, 2' to 4' long, entire or denticulate; lower petioled; upper sessile. Heads 6'' to 8'' wide, 40 to 50-flowered, on *short, stout pedicels*, in a racemose or at length corymbous panicle. *Involucre and pedicels thickly beset with dark, glandular bristles*. Akenes columnar, obtuse. Pappus yellowish-brown. Aug.

2. *H. Grondvii*, L. **HAIRY HAWKWEED. GRONOVII'S HAWKWEED.** A hairy plant, with a stiff, slender, wand-like, mostly simple stem, 1° to 3° high, leafy and hairy below, usually naked above, in a narrow, elongated panicle, common in dry and poor soils from Mass. to Ill. south to Fla. and La. Leaves hairy; radical ones obovate or oblanceolate, entire or denticulate, obtuse, 2' to 6' long, usually petioled; stem ones sessile, oval, or oblong. Involucres and slender pedicels somewhat glandular, with whitish hairs. Heads 15 to 20-flowered, numerous, 5'' to 8'' wide. Akenes spindle-shaped, tapering to the top. Pappus brown. July to Sept.

3. *H. venosum*, L. **PURPLE-VEINED HAWKWEED. RATTLESNAKE WEED.** A common plant, in dry woods from Me. to Minn. and Neb. south to Ga. and Ky., with a smooth, slender, scape-like stem, 1° to 3° high, naked or with a single leaf, forking repeatedly above into a loose panicle of 12 to 25-flowered heads, 6'' to 9'' wide, of bright yellow flowers. Leaves all radical, rosulate, obovate or oblong-spatulate, rather acute, nearly entire, petioled or sessile, thin, pale, slightly hairy, and usually marked with conspicuous purple veins above, purplish and glaucous beneath. Pedicels very slender. Scales glabrous. Akenes linear. June to Sept.

4. *H. paniculatum*, L. **PANICLED HAWKWEED.** A smooth, slender plant, rather common in dry or damp, open woods from Me. to Ga. west to Ky. and Ala., with a leafy stem, paniculately branched above, somewhat pubescent below, 1° to 3° high, and thin, glabrous, lanceolate, acute or acuminate, slightly toothed leaves, 2' to 4' long; no radical ones, at least when flowering. Heads 5'' to 7'' wide, usually many, 12 to 20-flowered, in a loose panicle, on slender, thread-like, diverging, often drooping pedicels. Akenes short, columnar, truncate. July to Sept.

5. *H. aurantiacum*, L. **ORANGE HAWKWEED. GRIM THE COLLIER. DEVIL'S PAINT BRUSH.** A European, stoloniferous species, naturalized and spreading rapidly in fields and cultivated grounds from New Eng. to Pa., with orange-red flowers in closely clustered heads at the top of a slender, leafless, hairy, scape-like stem, 6' to 20' high, and a rosulate cluster of hirsute, oblong to spatulate, obtuse, radical leaves. Involucres clothed with blackish hairs, whence one of its British names; its viciously spreading character, its blooms from June to Sept., scattering its seeds and sending out its stolons, along with its handsome flowers, has given it the other. June to Sept.

LIV. NÁBALUS, Cass. (PRENÁNTHEs, VAILL.) RATTLESNAKE ROOT. DROP FLOWER. North American and Asiatic, perennial herbs, with tuberous roots, erect, leafy stems, alternate, variable leaves, and numerous, small, usually drooping heads of ligulate, greenish-white, cream-colored, or purplish flowers, in terminal panicles or axillary clusters. Involucres cylindrical, slender, of 5 to 12 erect, linear scales in 1 row, and a few, small, appressed ones at the base. Receptacle flat, naked. Akenes linear-oblong, truncate. Pappus of copious, brownish, rough, capillary bristles.

1. *N. altissimus*, Hook. **TALL WHITE LETTUCE OR RATTLESNAKE ROOT.** A smooth, but not glaucous herb, of rich woods from Me. to Minn. south to Ga. and Tenn., with tall, slender, green or purplish stem, 3° to 7° high. Leaves thin, mostly long-petioled, varying from ovate,

cordate, or triangular, and cleft or toothed to deeply 3 to 5-parted, with cleft or entire segments. Heads numerous, pendulous, about 2" wide, 5 to 6-flowered, in a long, narrow, leafy panicle of small, loose, axillary and terminal clusters. Involucre slender, 5" to 6" by 1", of 5 smooth, greenish scales. Flowers greenish-white. Pappus light straw-color. July to Oct.

2. *N. serpentarius*, Hook. LION'S FOOT. GALL OF THE EARTH. A smooth or slightly pubescent, green herb, of dry, sterile soils from New Eng. to Fla. west to Ky. and Ala., with stout or slender stem, 2° to 3° high, corymbously paniculate at the top. *Leaves firm*, roughish, hastate or deltoid, often pinnately or palmately 3 to 7-lobed, especially the lower, and on winged petioles; the upper lanceolate, nearly entire, subsessile. Heads numerous, pendulous, about 3" wide, 8 to 12-flowered, in a corymbose panicle, with *divaricate, upcurved branches*. Involucre 5" to 7" by 1" to 2", of about 8 greenish or purplish, *more or less bristly scales*. Flowers cream-colored, greenish-white, or purplish. Pappus light straw-color. July to Oct.

3. *N. albus*, Hook. COMMON WHITE LETTUCE OR RATTLESNAKE ROOT. LION'S FOOT. A smooth and glaucous herb, common in rich, open woods from Me. to Minn. south to Ga. and Ky., with stout, often purplish stem, 2° to 4° high, corymbously paniculate at the top. *Leaves firm and variable in shape like those of No. 2*. Heads numerous, pendulous, 8 to 12-flowered, disposed in a corymbose panicle, with *recurving branches*. Involucre as in No. 2, but with the scales *glabrous or nearly so and glaucous*. Flowers dull white. Pappus dark brown. Aug., Sept.

LV. *TARAXACUM*, HALLER. DANDELION. Stemless, perennial herbs, with entire or toothed, sinuate or runcinate-pinnatifid, radical leaves, and naked, hollow scapes bearing solitary, terminal heads of ligulate, yellow flowers. Involucre double; the inner of nearly equal, linear, erect, appressed scales, somewhat united at base; the outer much shorter, spreading or reflexed. Receptacle flat, naked. Akenes smooth, oblong or spindle-shaped, tapering to a slender beak. Pappus of many, simple, capillary, persistent, dull white bristles.

1. *T. officinale*, WEBER. (*T. DENS-LEONIS*, LESS.) COMMON DANDELION. A cosmopolitan weed, regarded as naturalized in most of our area, from Europe, with a long, vertical root, spatulate-oblong to lanceolate, irregularly dentate to runcinate-pinnatifid, rosulate, radical leaves, 3' to 10' long, succulent, smooth, but pubescent when young. Outer scales reflexed.

After flowering and the closing of the inner involucre, the slender beaks of the akenes lengthen and also the scapes until, at maturity, the entire involucre is reflexed and the pappus, in an open, globular head, is raised high above the position of the previous flowers. Jan. to Dec.

LVI. *PYRRHOPAPPUS*, DC. FALSE DANDELION. North American, chiefly perennial herbs, with leafy or scape-like stems, alternate or radical leaves, and rather large, slender-peduncled heads of ligulate, golden-yellow flowers. Involucral scales, receptacles, akenes, and pappus nearly as in *Taraxacum*,

but the *pappus* is tawny or reddish, whence the generic name, *instead of white*, and *surrounded at the base with a hairy, white ring*.

1. *P. Carolinianus*, DC. A smooth perennial or annual (?), common in dry or sandy fields and pastures from Del. to Mo. south to Fla. and Tex., with leafy, simple, or branched stem, 1° to 2° high, with leaves mostly radical, oblong or lanceolate, acute, entire, toothed, lobed, or pinnatifid, 3' to 8' long; the few stem ones partly clasping. Outer scales awl-shaped or bristle-like, spreading; inner with a small spur at the top. April to July.

LVII. LACTUCA, TOURN. LETTUCE. Tall herbs, with leafy stems, alternate leaves, and yellow, blue, or sometimes whitish, ligulate flowers in small, paniced heads. Involucre cylindric or in fruit somewhat conoidal; scales imbricated, in 2 or more unequal rows. Receptacle naked. *Akenes* flat or flattish, orbicular, oval, oblong, or linear, *narrowed above into a long, filiform beak or into a short, slender, or thick neck, expanded at the top*, and bearing the *copious, soft, fine, fugacious, white or tawny, capillary pappus*.

§ SCARIOLO. Flowers yellow. Akenes beaked Nos. 1, 2, 3
§ MULGEDIUM. Flowers blue. Akenes beakless Nos. 4, 5

1. *L. Canadensis*, L. WILD OR TALL LETTUCE. TRUMPET MILKWEED. A smooth, glaucous, rank biennial or annual, common in rich, moist soils, along hedges or thickets, from Me. to Minn. south to Ga. and La., with a stout, hollow, very leafy, often purplish stem, 3° to 9° high, ending in a long, narrow or spreading, leafless panicle of numerous heads 4" to 6" long, 2" to 3" wide, with 12 to 20 pale yellow or purplish flowers. Leaves pale beneath, very variable, mostly sinuate-pinnatifid; stem ones sessile, 2' to 8' long; uppermost, and rarely all but the lowest, lanceolate and entire; radical ones often 12' long, narrowed to petioles. Akenes oval, flat, somewhat longer than the slender beak. Pappus white. July, Aug.

2. *L. Scariola*, L. PRICKLY LETTUCE. A tall, coarse, green, and glaucous, European, biennial weed, naturalized in fields and waste places from N.Y. and Pa. to Minn. and Mo., with a stiff, leafy, usually branched stem, 3° to 6° high, hirsute or sparsely bristly below, and a narrow or open panicle of numerous, small heads 2" to 4" wide, each of 6 to 12 pale yellow flowers. Leaves standing edgewise by a twist, lanceolate to oblong, with sagittate, clasping base, and denticulate, sinuate-toothed, or pinnatifid, prickly margin, and midrib prickly beneath. Akenes oblong-ovate, rather shorter than the beak. Pappus white. Aug., Sept.

3. *L. sativa*, L. GARDEN LETTUCE. A cultivated annual, unknown in its original wild state, but supposed to have been derived, centuries ago, in Asia, from No. 2. It has a corymbd stem, very smooth, yellowish-green, roundish leaves, upper ones cordate, and yellowish or whitish flowers in numerous, small heads. Cultivated in many varieties for salad.

4. *L. acuminata*, GRAY. HAIRY-VEINED BLUE LETTUCE. A tall biennial or annual, found in hedges, thickets, and borders of woods from N.Y. to Ill. south to Fla., Ga., and Ky., with a smooth, leafy, often purplish stem, 3° to 6° high, ending in a loose, leafless panicle, of numerous small heads of blue flowers. Leaves from ovate-oblong to oblong-lanceolate, acuminate at both ends, or stem ones sometimes sagittate or hastate, sharply

dentate, sessile, or petiolate, 3' to 6' long, smooth above, *sometimes hairy on the veins beneath*. Involucral scales dark purple. Akenes flattish, oblong, narrowed but not beaked at the top. Pappus white. Aug., Sept.

5. *L. leucophæa*, GRAY. TALL BLUE LETTUCE. A tall, nearly smooth biennial or annual, rather common in low or moist ground from Canada to N.C. and Tenn., with stout, leafy stem, 4° to 10° high, lyrate-runcinate, coarsely toothed, sessile, clasping, or petioled leaves 5' to 12' long, and heads of bluish to dusky white (*leucophæa*) flowers, in a long, slender, compound panicle. Akenes oblong, flattish, with a short neck. *Pappus tawny*. July to Oct.

LVIII. SÓNCHUS, L. SOW THISTLE. Annual or perennial, Old World herbs, with alternate or radical, entire, toothed, pinnatifid, or dissected leaves, stem ones often sagittate-clasping, and irregularly corymbed or umbellate, rarely solitary heads of ligulate, yellow flowers. Involucre swollen at base in fruit, of many, unequal, imbricated scales. Receptacle flat, naked. Akenes flattened, not beaked. Pappus of copious, fine, soft, silky, white hairs, usually falling off together.

1. *S. oleráceus*, L. COMMON SOW THISTLE. A European, annual weed, naturalized and common in waste places around dwellings throughout our area and around the globe. Stem nearly simple, angular, hollow, leafy below, 2° to 5° high, from fibrous roots. *Stem leaves sagittate-clasping*, runcinate-pinnatifid, or rarely undivided, the margins denticulate, with soft, spiny teeth; uppermost often lanceolate and entire; radical and lower ones petioled, 4' to 10' long, lyrate-pinnatifid, with usually a large, triangular, terminal segment. Flowers pale yellow, in heads 9" to 15" wide. Akenes flat, striate, or ribbed lengthwise, wrinkled transversely. Called also *Hare's Lettuce*, *Milk Thistle*, etc. The leaves have been used as a pot herb (*oleraceus*) and as a salad. May to Nov.

2. *S. ásper*, VILL. SPINY-LEAVED SOW THISTLE. An annual similar to No. 1 in origin, habitat, and range, but less common, and with less divided and more spiny-toothed leaves, which are *cordate-clasping*, oblong-lanceolate, undulate, and prickly-dentate above, the lower and radical ones obovate or spatulate. May to Nov.

ORDER 55. LOBELIACEÆ—LOBELIA FAMILY

Herbs or shrubs, with milky, usually acrid juice, alternate or radical, exstipulate leaves, and scattered, perfect flowers. Calyx tube adherent, limb 5-cleft. *Corolla monopetalous, irregularly 5-lobed, cleft on one side nearly or quite to the base*. Stamens 5, epigynous, united into a tube, at least by their anthers. Style 1; stigma often fringed. Fruit usually a 1 to 3-celled pod. Seeds many, albuminous. Mostly tropical and subtropical.

I. LOBELIA, L. Annual or perennial herbs, sometimes shrubs in the tropics, with blue, red, white, or yellow flowers in spikes or racemes, or solitary in the axils. Corolla tubular, cleft apparently by the twisting of the pedicel, on the upper side; somewhat 2-lipped; the upper lip of 2 separate, slightly erect lobes; the lower 3-lobed. Anthers united into a curved tube. Stigma 2-lobed. Pod 2-celled, opening at the top. Seeds minute. Summer and autumn.

1. L. cardinalis, L. CARDINAL FLOWER. SCARLET LOBELIA. A stately herb, perennial by offsets, common throughout our area in low, wet grounds, especially along small streams and meadow rivulets, and very conspicuous when in bloom, with simple or rarely branched, smooth or smoothish, leafy stem, 2° to 4° high, thin, oblong-lanceolate, slightly toothed leaves 2' to 4' long, and *deep scarlet or intensely red, rarely white flowers* 12'' to 18'' long, in a terminal, bracted, rather one-sided raceme. July to Sept.

2. L. syphilitica, L. GREAT LOBELIA. A somewhat hairy herb, perennial by offsets, common in low, moist grounds from Me. to Minn. and Kan. south to Ga. and La., with a rather stout, angular, usually simple, very leafy stem, 2° to 3° high, thin, green, oblong-lanceolate, acute or acuminate, irregularly serrate leaves 2' to 4' long, and light blue, rarely white flowers 10'' to 12'' long, in a dense, leafy-bracted raceme. July to Sept.

3. L. inflata, L. INDIAN TOBACCO. A very common annual, of dry soils in fields and woods from Me. to Minn. and Neb. south to Ga. and Ark., with a fibrous root and an erect, rough, hairy stem, 10' to 20' high, simple or branched according to the vigor of its growth. Leaves thin, hairy, veiny, obtusely toothed, ovate, oblong, or oval, obtuse or acute; lower ones narrowed to a petiole; upper ones sessile, gradually diminishing in size to leaf-like bracts. Flowers light blue, 2'' to 3'' long, in terminal and axillary, peduncled, spike-like, bracted racemes. Calyx ovoid, smooth, with subulate lobes as long as the corolla, becoming in fruit an *inflated pod* 3'' to 4'' long, on the lengthened pedicel. A poisonous plant, famous in pharmacy as emetic, expectorant, and sudorific. July to Sept.

ORDER 56. CAMPANULACEÆ — BELLFLOWER FAMILY

Herbs, with milky juice, alternate, simple, exstipulate leaves, and perfect, usually showy, blue, violet, or white flowers. Calyx adherent, persistent, usually 5-cleft. Corolla regular, monopetalous, campanulate or rotate, 5-lobed or 5-parted, withering, valvate in the bud. Stamens 5, distinct, free from the corolla. Style 1, usually clothed above with collecting hairs. Stigmas 2 to 5. Pod with 2 or more cells, loculicidal. Seeds many, albuminous. Chiefly of temperate regions.

I. CAMPANULA, TOURN. BELLFLOWER. Mostly perennial herbs, with racemed, spicate, or solitary, terminal or axillary flowers. Calyx 5-cleft. Corolla bell-shaped or somewhat wheel-shaped, 5-lobed, closed at base by the valve-like bases of the 5 stamens. Stigmas and cells of the short pod 3 to 5, in American species 3, the pod opening by as many valves or clefts.

1. *C. Americana*, L. **TALL BELLFLOWER.** An annual or biennial (?), common in moist woods and thickets from Me. to Minn. south to Fla., Ky., and Ark., and also cultivated for ornament with nearly smooth, rather erect and slender, simple or rarely branched stem, 2° to 4° high. Leaves thin, somewhat hairy, ovate-lanceolate, 3' to 6' long, serrate, acuminate, narrowed to a winged petiole, or the upper ones sessile. *Flowers with rotate, deeply 5-cleft, blue or white corolla, about 1' wide, in a terminal, often leafy spike 1° to 2° long. Style exserted, strongly declined and curved upward. July to Sept.*

2. *C. rotundifolia*, L. **HAREBELL. BLUEBELLS OF SCOTLAND.** An interesting perennial, the most cosmopolitan of the genus and the real *Bluebells of Scotland* and *Harebell* of literature, found on moist rocks and shaded, rocky banks from N.J. to Neb. and northward, also southward along the mts. in our area, and in the same latitudes around the globe. From a creeping rootstock, it sends up one or more very slender, erect or diffuse, simple or branching stems, 5' to 15' high, with slender, linear, entire, sessile leaves on the stem and branches, and from the roots several round or roundish, heart-shaped, toothed or crenate, long-petioled ones, 9'' to 12'' wide, which give it its specific name (*rotundifolia*), but usually wither and disappear before the time of flowering. Flowers few or many, in racemes or a loose panicle, on slender, usually drooping pedicels. Calyx lobes awl-shaped, much longer than the top-shaped tube, and about half the length of the blue, bell-shaped corolla, which is 6'' to 9'' long. Larger and coarser in cultivation. June to Sept.

3. *C. aparinoides*, PH. **MARSH OR BEDSTRAW BELLFLOWER.** A minutely prickly perennial, with slender rootstock, wiry, almost filiform, reclining or diffuse, somewhat triangular stems, 12' to 20' high, hispid backward on the angles, found in marshes and wet meadows from Canada to Ga., Ky., and Neb. Leaves linear-lanceolate, 1' to 2' long, sessile, slightly toothed or entire, rough on the edges and midrib. Flowers light blue, nearly white or pink, broad bell-shaped, 4'' wide, on filiform pedicels, in a terminal, leafy panicle. Calyx lobes triangular, as long as the tube, half as long as the deeply 5-cleft corolla. Buds drooping; flowers and pods erect. With the general habit of a Bedstraw, it supports itself in the grass in the same way, whence its specific name (*aparinoides*). June to Aug.

4. *C. Medium*, L. **CANTERBURY BELLS.** A well-known garden biennial from southern Europe, with erect, simple or branched, hairy stem, 1° to 4° high, ovate-lanceolate, crenately toothed, sessile leaves, and loose, many-flowered racemes, of large, blue, purple, red, or white flowers. Corolla oblong-bell-shaped, 2' to 3' long. Calyx with a reflexed, leafy appendage at the base of each sinus. Stigmas 5. Pod 5-celled. The specific name (*Medium*) refers not to size, but is the name of an old genus, whence capital *M*, etc. June to Sept.

II. SPECULARIA, HEISTER. VENUS'S LOOKING-GLASS. Annual herbs, with alternate, entire or toothed leaves, and blue, purple, violet, or white, sessile or short-peduncled, terminal or

axillary, 2-bracted flowers, the lower, earlier ones in American species inconspicuous and cleistogamous, the upper, later, large, and showy. Calyx 5-lobed, with long tube. Corolla more or less rotate, 5-lobed. Stamens 5, separate, the flat, hairy filaments shorter than the anthers. Stigmas 3. Capsule prismatic or somewhat cylindric, oblong, 3-celled, opening laterally in the upper part.

1. *S. perfoliata*, LAM. AMERICAN VENUS'S LOOKING-GLASS. A somewhat hairy plant, common in dry fields, sterile, open grounds, and by roadsides throughout our area, with strict, upright, usually simple stem, 6' to 24' high, and short, roundish, or broadly ovate, crenate-dentate, *stem-clasping* leaves 6'' to 12'' wide, with 1 to 3 sessile flowers in their axils, only the later, i.e. the upper ones, conspicuous for their blue or violet, wheel-shaped corollas 5'' to 10'' wide. Lower flowers, with 3 to 4 calyx lobes shorter than the imperfect corollas, cleistogamous. May to Aug.

2. *S. Spéculum*, L. COMMON, EUROPEAN OR GARDEN VENUS'S LOOKING-GLASS. A hardy, ornamental annual from Europe, with erect, branched stem, 9' to 12' high, lower leaves obovate, entire, upper ones ovate-oblong or lanceolate, nearly entire, and somewhat wheel-shaped, or broadly bell-shaped, solitary and terminal, purple or blue, varying to white flowers. Calyx tube linear, constricted at the top, nearly 1' long, with lobes at length reflexed. July, Aug.

ORDER 57. ERICACEÆ — HEATH FAMILY

Shrubs or small trees, rarely perennial herbs, with simple, undivided, exstipulate, mostly evergreen, usually alternate leaves, and perfect, mostly regular flowers. Calyx, except in Suborder I, free. Corolla monopetalous, 4 to 5-lobed, or sometimes polypetalous, 4 to 5-petaled. Stamens as many or twice as many as the lobes or petals of the corolla, free from it, and except in Suborder I, hypogynous. Anthers 2-celled, generally appendaged, often opening by terminal pores. Pollen, except in Suborder IV, and the genus *Clethra* of Suborder II, composed of 4 united grains. Styles and stigmas united into 1. Ovary 2 to 10-celled, many-seeded.

Key to Genera

Ovary adherent, in fruit a berry.	Shrubs	SUBORDER I
Ovary free.	Shrubs or trees	SUBORDER II
Ovary free.	Low, half-woody herbs	SUBORDER III
Ovary free.	Low, leafless, verdureless herbs	SUBORDER IV

Suborder I. VACCINIEÆ. HUCKLEBERRY SUBFAMILY.

Erect shrubs. Flowers 5-petaled.	Berries 10-seeded . . .	GAYLUSSACIA *
Erect shrubs. Flowers 5-petaled.	Berries many-seeded . . .	VACCINIUM *
Trailing or creeping evergreens.	Flowers 4-parted. Berries red	OXYCOCUS *
Trailing or creeping evergreens.	Flowers 4-parted. Berries white	CHIOGENES *

Suborder II. ERICINÆ. HEATH SUBFAMILY.

- Flowers 4-parted. Stamens 8. Capsule 4-celled, septicidal . . . **MENZIESIA** *
- Flowers 5-parted. Petals united. (a)
- Flowers 4 to 7-parted. Petals distinct. (d)
- a. Corolla saucer-shaped, the 10 anthers in 10 pits . . . **KALMIA** I
- a. Corolla salver-shaped, very fragrant. Trailing shrublet . . . **EPIGÆA** II
- a. Corolla urn-shaped (ovoid, cylindric, or globular). (b)
- a. Corolla funnel-shaped or bell-shaped, with spreading lobes. (c)
- b. Fruit fleshy, 5-seeded . . . **ARCTOSTAPHYLOS** *
- b. Fruit fleshy, many-seeded . . . **GAULTHERIA** III
- b. Fruit dry, capsular, loculicidal. Leaves linear, moss-like . . . **CASSIOPE** *
- b. Fruit dry, capsular. Shrubs with ample leaves . . . **ANDRÔMEDA** *
- b. Fruit dry, capsular. Trees with ample leaves . . . **OXYDENDRUM** IV
- c. Stamens 10. Style not exserted. Leaves evergreen . . . **RHODODENDRON** V
- c. Stamens 10. Style not exserted. Leaves deciduous . . . **RHODORA** *
- c. Stamens 5. Style long-exserted. Leaves deciduous . . . **AZALEA** VI
- d. Petals 4. Stamens 8 . . . **ELLIÔTTIA** *
- d. Petals 7. Stamens 14 . . . **BEJARIA** *
- d. Petals 5. Capsule 5-celled . . . **LÊDUM** *
- d. Petals 5. Capsule 3-celled. Flowers umbel . . . **LEIOPHYLLUM** *
- d. Petals 5. Capsule 3-celled. Flowers racemed . . . **CLETHRA** VII

Suborder III. PYROLÆ. PYROLA SUBFAMILY.

- Flowers racemed, many. Low, nearly aculescent . . . **PYROLA** VIII
- Flowers umbel, few. Stems ascending . . . **CHIMAPHILA** IX
- Flowers solitary. Low, aculescent . . . **MONÈSES** *

Suborder IV. MONOTROPÆ. INDIAN PIPE SUBFAMILY.

- Corollas polypetalous, white, tawny, or reddish . . . **MONOTROPA** X
- Corollas monopetalous, bell-shaped, in a short spike . . . **SCHWEINITZIA** *
- Corollas monopetalous, ovoid, in a loose raceme . . . **PTEROSPORA** *

* See fuller floras. For ELLIOTTIA and BEJARIA, see Chapman or Wood.

I. KÁLMIA, L. AMERICAN LAUREL. Erect, branching, evergreen shrubs, with alternate, opposite or whorled, entire, coriaceous leaves, and showy, corymbed or solitary flowers. Calyx 5-parted. *Corolla saucer-shaped, somewhat 5-lobed, with 10 cavities holding the 10 anthers, which, when released, are thrown upward by the slender, elastic filaments, to discharge their pollen.* Capsule globose, 5-celled, 5-valved, many-seeded. Of 6 known species, 5 are of eastern North America and 1 West Indian.

1. K. latifolia, L. MOUNTAIN LAUREL. SPOONWOOD. CALICO BUSH. A very handsome shrub, duly appreciated only away from its own country, as in English parks, common in wet, sandy soils and rocky hills from Me. to western Fla., chiefly along the mts. and west to Ohio, Ky., and Tenn., usually 4° to 8° high, but in the mts. sometimes 10° to 20°, or even more, with stiff branches and profuse masses of wax-like flowers in terminal corymbs. Leaves petioled, mostly alternate, sometimes opposite or in 3's, smooth and green on both sides, flat, oval-lanceolate, acute at each end, 2' to 3' long. Flowers 9'' to 10'' wide, varying from deep rose-color to white. Corymbs clammy-pubescent. Pedicels erect in fruit. Calyx and style persistent, the latter falling away on the opening of the depressed-globose pod. Leaves poisonous to some animals. The compact, fine-grained wood as utilized by the Indians occasions one of its vernacular names; and the suggestion by the flowers of certain patterns of calico another. May, June.

2. *K. angustifolia*, L. SHEEP LAUREL. LAMBKILL. WICKY. A slender, upright shrub, 1' to 3' high, usually simple, sometimes with a few erect branches, common in marshes and moist soils from Me. to Mich. south to Ga. Leaves petioled, usually opposite or in 3's, smooth, light green above, pale beneath, narrowly oblong, obtuse at each end, 1' to 2' long. Flowers deep pink, crimson, or purple, 3'' to 5'' wide, in slightly glandular, lateral corymbs. Pedicels recurved in fruit. Said to be poisonous to cattle, and called also *Calkill* and *Sheep Poison*. May, June.

II. *EPIGÆA*, L. Trailing, tufted, slightly shrubby perennials, with alternate, entire, petioled, leathery, evergreen leaves, and large, perfect, dimorphous or dioecious flowers, sessile, in terminal or axillary clusters. Calyx 5-parted, 3-bracted. Corolla salver-shaped; tube hairy within; limb 5-parted, spreading. Stamens 10, with slender filaments attached to the base of the corolla; anthers opening lengthwise. Style columnar; stigma 5-lobed. Capsule depressed-globose, hairy, 5-celled, many-seeded. The only known species are the one below and one of Japan.

1. *E. repens*, L. TRAILING ARBUTUS. GROUND LAUREL. MAYFLOWER. A little, creeping plant, of sandy and rocky soils from Me. to Minn. south to Fla. and Ky., with stems 10' to 15' long, spreading over the ground in patches, bristly on stem and branches, with rusty hairs, thick, more or less oval, obtuse, or acute leaves, green on both sides, smooth above, hairy beneath, 1' to 3' long, on hairy petioles, and pink to white, very fragrant flowers. The first of the above vernacular names is properly pronounced Ar'-bu-tus, not Ar-bu'-tus, as in common usage. April, May.

III. *GAULTHERIA*, KALM. Small trees, shrubs, or nearly herbaceous plants, mostly South American, with alternate, rarely opposite, smooth, shining, leathery, evergreen leaves, and small, racemed or solitary, axillary and terminal, white, pink, or red flowers. Calyx 5-lobed, 2-bracted, sometimes enlarging after flowering and becoming fleshy, and with the 5-celled capsule forming a berry-like fruit. Corolla urn-shaped or bell-shaped, with 5 small, recurved or spreading lobes. Stamens 10, included. Anther cells opening by a terminal pore, and usually awned.

1. *G. procumbens*, L. CREEPING WINTERGREEN. CHECKERBERRY. A little, shrubby plant, with slender, creeping, often subterranean stems, and ascending or erect branches, flowering and leafy at the top, 2' to 5' high, well known for its spicy leaves and berries, and common in woods, especially under evergreens, from New Eng. to Mich. and south in the Atlantic States to upper Ga. Leaves mostly at the top of the branches, on short petioles, oval, obovate, or oblong, obtuse or acute, mucronate, 1' to 2' long, with slightly revolute, denticulate margins, dark green and shining above and pale beneath. Flowers few, usually single, axillary, on recurved peduncles. Corolla nearly white, ovoid, 3'' to 4'' long. Fruit a

depressed-globose, bright red, mealy, spicy berry 3" to 5" in diameter, lasting through the winter. Called also *Mountain Tea*, *Boxberry*, *Tea-berry*, and unfortunately sometimes also *Partridge Berry*, which *Mitchella repens* claims as peculiarly its own. June to Sept.

IV. OXYDENDRUM, DC. Genus monotypic. A tree, with alternate, deciduous, petioled, oblong-lanceolate, acuminate, serrulate leaves, and small, white, fragrant flowers in terminal panicles of slender racemes. Calyx bractless, with 5 valvate, persistent sepals. Corolla ovoid, narrowed at the throat, 5-toothed. Stamens 10; anthers linear, awnless, opening lengthwise. Capsule oblong, truncate, 5-celled, 5-valved, many-seeded. Pedicels 2-bracted near the middle.

1. *O. arboreum*, DC. **SORREL TREE. SOURWOOD.** A slender tree, 15° to 40° high, of rich woods from Pa. to Ind. and southward, especially along the mts. to Fla. and Ala., with a reddish-gray, deeply furrowed bark, slender, spreading branches, and *sour leaves*, whence the generic and popular names, resembling those of the peach tree, and 4' to 5' long. Racemes slender, 1-sided, 7' to 8' long. Wood reddish-brown, heavy, hard, close-grained, taking a high polish. June, July.

V. RHODODENDRON, L. Shrubs or trees, of the northern hemisphere, mostly Asiatic, with alternate, entire, *evergreen leaves*, and mostly large, handsome, rose-colored, white, or purple flowers, in close, umbeloid or corymbed clusters, from large, terminal, scaly-bracted buds. Calyx small or minute, 5-parted or 5-lobed. Corolla bell-shaped, 5-lobed, often slightly irregular. Stamens 10, sometimes 5 to 10, *scarcely exerted*, usually declined, *sometimes spreading equally*; anthers awnless, each cell opening by a terminal pore. Style slender, rarely exerted. Capsule 5-celled, 5-valved, many-seeded, opening septicidally from the top.

1. *R. maximum*, L. **BIG OR GREAT LAUREL. ROSE BAY.** A large shrub, usually 10° to 15° high, but sometimes in the South attaining tree-like proportions, with very divergent and crooked branches, found in damp, deep woods from New Eng. to Ohio, becoming common in the mts. of N.Y. and N.J., and still more so farther south, often forming dense thickets of many acres in the mts. southward to Va., N.C., and Ga. Leaves very thick, smooth, dark green above, usually whitish or rusty beneath, obovate-oblong or oblong-lanceolate, acute, with slightly revolute margin, 4' to 8' long, on stout petioles 6" to 12" long. Flowers in dense corymbs of 15 to 20, on viscid pedicels 1' to 2' long. Corolla rose-color to white, dotted with purple or orange, 18" to 24" wide, somewhat unequal, with 5 roundish lobes. Flower-bud scales nearly 1' long, abruptly acuminate. July, Aug.

2. *R. Catawbiense*, Mx. **CATAWBA ROSE BAY. RED RHODODENDRON.** A shrub, 3° to 6° high, similar to No. 1, and forming like it extensive thickets, confined in its wild state to the highest mountain summits of Va., N.C., and Ga., but often cultivated and varied by hybridization with

other species. Leaves smooth, dark green above, pale or glaucous beneath, oval or broadly oblong, obtuse or rounded at each end, 3' to 5' long, on stout petioles 6'' to 18'' long. *Corolla lilac-purple, without spots, broadly bell-shaped, 24'' to 30'' wide, with broad, rounded lobes.* June, July.

VI. AZALEA, L. AZALEA. Erect, branching, Asiatic and North American shrubs, sometimes included in *Rhododendron*, with alternate, oblong or obovate, *thin, deciduous leaves*, and handsome pink, white, rose-colored, orange, buff, or purple flowers in terminal umbels, from scaly-bracted buds. Calyx small or minute, 5-parted. *Corolla with conspicuous, funnel-shaped tube and slightly irregular, often 2-lipped, 5-lobed, spreading limb.* Stamens usually 5, sometimes 5 to 10, and with the style declined and long-exserted; anthers awnless, opening by terminal pores. Capsule 5-celled, 5-valved, opening septicidally from the top, many-seeded.

1. *A. nudiflora*, L. **NAKED-FLOWERED AZALEA. PINXTER FLOWER.** A shrub, 2° to 6° high, branched above, *with branchlets often in irregular whorls, and flowers appearing in naked clusters before or with the leaves (nudiflora),* common in dry, sandy, or rocky woods and thickets, or on hillsides, as also in swamps and low grounds, from Me. to Ill. south to Fla. and Tex. Leaves obovate or oblanceolate, acute at each end, downy beneath, 2' to 4' long, on short petioles. Calyx lobes minute. *Corolla slightly viscid, with downy tube scarcely longer than the ample lobes.* Stamens sometimes more than 5, and with the style very much exserted. Color varying greatly from light pink to buff and deep purple. Fragrance usually absent, but sometimes present.

The common popular name, *Wild Honeysuckle*, often applied to this as well as to other species, is unfortunate as a misleading misnomer, while *Pink* and *Purple Azalea*, to which could be added *Flame-colored* and *Buff Azalea*, fit only varieties. *Pinxter Flower*, i.e. *Easter Flower*, is only less inappropriate as referring to the time of blooming, which varies with the latitude and other conditions from April to June.

2. *A. viscosa*, L. **CLAMMY AZALEA. WHITE AZALEA.** A shrub, 4° to 7° high, with *hairy or bristly twigs and clammy flowers (viscosa), appearing with or after the leaves,* common in swampy and low grounds and moist woods from Me. to Ohio south to Fla. and Tex. Leaves oblong-ovate to oblanceolate, obtuse, mucronulate, 2' to 4' long, more or less bristly on the edges, midvein beneath, and very short petiole. *Flowers fragrant, white or rose-color, with slender, downy, clammy tube much longer than the lobes.* Calyx lobes minute. Sometimes called also *Swamp Pink* or *Swamp Honeysuckle*. Var. *glauca*, GRAY, with leaves white-glaucous beneath or on both sides, is found from New Eng. to Va.; while Var. *nitida*, GRAY, a dwarf form with shining leaves, smooth and green on both sides, occurs in mountain swamps from N. Y. to Va. June, July.

VII. CLËTHRA, L. Shrubs or trees, with alternate, usually serrate, and in our species deciduous leaves, and white flowers in terminal, paniced or solitary racemes. Calyx 5-parted, persistent. Petals 5, obovate, oblong, or obcordate. Stamens 10, sometimes exserted; anthers sagittate, inverted in bud, at

length erect, the cells opening by terminal pores. Pollen grains simple. Style slender, 3-cleft at the top, persistent. Ovary 3-celled, loculicidally 3-valved, many-seeded, inclosed by the calyx. Plants chiefly of America and eastern Asia.

1. *C. alnifolia*, L. WHITE ALDER. SWEET PEPPER BUSH. A handsome shrub, 3° to 8° high, often cultivated for ornament, native in swamps and wet woods and copses from Me. to northern N.J. and thence near the coast to Fla. Leaves deciduous, wedge-obovate, sharply serrate above, entire toward the base, smooth, green on both sides, straight-veined, 2' to 3' long, on short petioles. Flowers white, fragrant, 4'' to 5'' wide, in terminal, simple or branched, upright racemes 3' to 5' long. Stamens exserted. Bracts shorter than the flowers. Several varieties occur, as, *Var. tomentosa*, Mx., with leaves downy or tomentose beneath; common in the South. July to Aug.

2. *C. acuminata*, Mx. MOUNTAIN SWEET PEPPER BUSH. A tall shrub or small tree, 10° to 18° high, similar to No. 1, found along streams in mountain woods from Va., W.Va., and Ky. to S.C. and Ga., with oval or oblong, acuminate, finely serrulate, smooth, thin leaves 4' to 6' long, green above, pale and glaucous beneath, on slender petioles 5'' to 10'' long. *Racemes usually solitary, nodding.* Bracts longer than the flowers. July, Aug.

VIII. *PÝROLA*, L. Low, smooth, stemless or nearly stemless, stoloniferous, perennial herbs, bearing a cluster of radical or alternate and cauline, usually long-petioled, rounded, evergreen leaves, and a simple raceme of white, whitish, pink, or purplish, nodding flowers, on an erect, scaly-bracted or naked scape. Calyx 5-parted, persistent. Petals 5, concave, more or less converging. Stamens 10; anthers large, erect in the bud, inverted in the flower, opening by 2 pores in the 2-beaked base or apparent apex. Style usually long. Stigma 5-lobed. Capsule subglobose, 5-celled, loculicidally 5-valved from the base. Seeds minute, very many. The species of this genus are known in England as *Wintergreen*.

1. *P. elliptica*, NUTT. SHIN LEAF. A little plant of rich woods from Me. to Minn. south to Md. and Ill., with *dull green, thin, elliptical, obovate or oval, obscurely dentate leaves, longer than the margined petiole*, and usually a *naked scape 5' to 10' high, bearing at the top a short raceme of 7 to 15 very fragrant, greenish-white flowers 6'' to 8'' wide.* Calyx lobes ovate-triangular, scarcely one-fourth as long as the petals. Stamens ascending. Style strongly declined, the end curved upward. Pedicels longer than the bracts. June to Aug.

2. *P. rotundifolia*, L. A little plant, common to the woods of Great Britain, Europe, and our own country from Ga. to Ohio and northward, with *thick, shining, orbicular, oval, or ovate leaves, usually shorter than the dilated petiole, and a many-bracted, 3-angled scape 6' to 20' high, bearing a long raceme of fragrant white flowers.* Stamens and style as in No. 1. Calyx lobes lanceolate or oblong, about one third as long as the petals. Many varieties are found, especially northward, with flowers varying from pink to rose-purple. June, July.

IX. CHIMÁPHILA, PURSH. Low, perennial herbs, with long, running, underground stems, and short, ascending branches bearing a few scattered, opposite or somewhat whorled, thick, leathery, evergreen, short-petioled, serrate leaves, and a few, fragrant, white or purplish, wax-like flowers on a terminal, naked peduncle. Calyx 5-parted. Petals 5, orbicular, concave, widely spreading. Stamens 10; filaments short, dilated and hairy in the middle; anther cells oblong, with a narrow neck, opening by a 2-lipped pore at the top. Style very short. Stigma large, orbicular, with 5-crenate border. Capsule 5-celled, opening from the top.

1. *C. umbellata*, NUTT. PIPSISSEWA. PRINCE'S PINE. A little evergreen, common in dry, especially coniferous woods from Canada to Ga. west to the Pacific, and more or less in the same latitudes around the globe, sending up from its creeping stem both sterile and fertile branches 4' to 10' high, with irregularly clustered or whorled, shining, deep green, wedge-lanceolate, sharply serrate leaves 2' to 3' long, and the fertile ones a terminal, peduncled umbel or corymb of 4 to 7 pinkish or light purple flowers 6'' to 9'' wide, usually marked with a colored ring. Leaves regarded as medicinal. June to Aug.

2. *C. maculata*, PURSH. SPOTTED WINTERGREEN. A plant common in dry woods from Canada to Ga. and Miss., similar in habit to No. 1, but with smaller and less leafy branches, 3' to 6' high, ovate-lanceolate, remotely toothed leaves, rounded at the base, 1' to 2' long, the upper surface a dull, dark green, streaked along the veins or mottled with white, and a terminal, peduncled corymb of 2 to 3 purplish-white flowers 8'' to 10'' wide. June to Aug.

X. MONÓTROPÁ, L. Low, white, tawny, or reddish, fleshy herbs, with erect, clustered, leafless, verdureless, scaly-bracted stems, rising in summer from a matted mass of fibrous rootlets, parasitic, on roots, or growing, fungus-like, from decomposing vegetable matter, bearing one or several nodding flowers, which become erect in fruit. Sepals 2 to 5, bract-like, lanceolate, deciduous. Petals 4 to 6, oblong, connivent in a bell-shaped or ovoid corolla, tardily deciduous. Stamens 8 to 10, awl-shaped; anthers opening across the top. Style columnar, tubular; stigma discoid, 5-rayed. Capsule ovoid, 4 to 5-celled, 4 to 5-valved, loculicidal. Seeds minute, innumerable.

§ 1. *MONOTROPA* proper. Flowers solitary, scentless. Style very short . . . No. 1
 § 2. *HYPOPHYTIS*. Flowers in a second raceme, fragrant. Style long . . . No. 2

1. *M. uniflora*, L. INDIAN PIPE. A smooth, fleshy plant, with simple, wax-like, pearl-white, clustered, erect stems, 4' to 8' high, scaly bracts for leaves, and a single, nodding, terminal, pearl-white flower, suggesting its scientific and common names, the stem lengthening and the flower becoming erect in maturing; the entire plant turning black in drying and suggesting another common name *Corpse Plant*. Flower inodorous, oblong-bell-shaped, 6'' to 8'' long, with yellowish anthers.

Common in damp woods throughout the U.S. and Canada. Found also in Japan and the Himalayas. June to Sept.

2. *M. Hypópitys*, L. PINE-SAP. FALSE BEECH DROPS. A more or less downy, tawny, or reddish, fleshy plant, with stem 4' to 6' high, scales for leaves, and a short, close, scaly raceme of several, usually fragrant, ovoid flowers much smaller than in No. 1, the terminal one usually 6-merous, the others 3 to 4-merous, the flowers nodding at first, but erect in fruit. Found in oak and pine woods from Canada to Fla. west to Ore., but very rare, compared with No. 1. Found also in Europe and Asia. June to Aug.

ORDER 58. PRIMULACEÆ — PRIMROSE FAMILY

Herbs, with usually radical or opposite, sometimes whorled or alternate, mostly simple, exstipulate leaves, and perfect, mostly regular flowers, sometimes axillary and solitary, often umbeled, racemed, or solitary at the apex of a scape. Calyx free from the ovary, or very rarely adherent, usually 5 (4 to 9) -cleft or -parted. Corolla monopetalous, rarely polypetalous, or wanting. Stamens 4 or 5, on the tube or base of the corolla, opposite its lobes. Style and stigma 1. Ovary mostly superior, 1-celled, with a free, central placenta. Capsule 1-celled, many-seeded. Widely distributed, mostly of the northern hemisphere.

Key to Genera

- a. Ovary entirely free. (b)
- a. Ovary partly adherent. (h)
- b. Capsules opening by valves or teeth. (c)
- b. Capsules opening by a lid. Flowers axillary. (g)
- c. Leaves pectinate, immersed. Aquatics **NOTTONIA** *
- c. Leaves undivided. (d)
- d. Stemless herbs. Leaves radical. (e)
- d. Leafy-stemmed herbs. (f)
- e. Corolla limb spreading, tube cylindric **PRIMULA** I
- e. Corolla limb spreading, tube ovoid **ANDROSACE** *
- e. Corolla lobes reflexed. Stamens exserted **DODECATHEON** II
- e. Corolla lobes reflexed. Stamens included **CYCLAMEN** *
- f. Corolla wanting. Calyx petaloid. Leaves opposite **GLAUX** *
- f. Corolla 7-parted. Leaves terminal, apparently whorled **TRIENTALIS** III
- f. Corolla 5 to 6-parted. No sterile filaments. Leaves dotted **LYSIMACHIA** IV
- f. Corolla 5-parted. Sterile filaments between the stamens **STEIRONEMA** V
- g. Leaves opposite **ANAGALLIS** VI
- g. Leaves alternate **CENTUNCULUS** *
- h. Corolla bell-shaped, 5-parted. Flowers racemed. Leaves alternate **SAMOLUS** *

* Consult a fuller flora.

I. **PRÍMULA**, L. PRIMROSE. COWSLIP. Low, mostly Old World perennials, with tufted, radical, veiny leaves, and white, pink, purple, or yellow, dimorphous flowers, mostly in an involucrate umbel on a simple scape. Calyx tubular, funnel-

form or bell-shaped, often angled, 5-cleft, persistent. Corolla salver-form or often funnel-form, with 5 entire, notched or bifid lobes. Stamens 5, included. Capsule ovoid, oblong, or globose, many-seeded, opening at the top by 5 valves or 10 teeth.

1. *P. grandiflora*, LAM. (*P. vulgaris*, HUDS.) COMMON PRIMROSE. A European and British plant, common in gardens in many varieties, with numerous, tufted, obovate-oblong, toothed, rugose leaves, villous beneath, sessile or tapering to a slender base, 6' to 9' long, and sessile (or sometimes short-stemmed) umbels of normally pale yellow flowers 1' or more wide, with flat limb, on slender pedicels about as long as the leaves; in cultivation, varying to all shades of orange and red to white, single or double. Calyx 5-angled, with acute or acuminate lobes. April.

2. *P. officinalis*, JACQ. (*P. vèris*, L.) COWSLIP PRIMROSE. ENGLISH COWSLIP. A European and British species, with hairy, rugous, oval or oblong leaves abruptly contracted to a winged petiole, and a stout scape 6' to 12' high, bearing a close umbel of 6 to 12 nodding, bright yellow flowers, with a concave or cup-shaped limb 6'' to 9'' wide, an orange throat, and a tube about as long as the obtuse or half-acute lobes of the large, loose, angular calyx. May, June.

3. *P. elatior*, JACQ. OXLIP. OXLIP PRIMROSE. A European and British species similar to No. 2, but taller (elatior), the scape 1° high, with larger flowers, opening more widely, with nearly flat limb 12'' to 18'' across, and a narrow calyx with acuminate lobes. Regarded as intermediate between Nos. 1 and 2. April, May.

4. *P. Polyanthus*, HORT. POLYANTHUS. The most common form of hardy American garden primroses, in several varieties, supposed by some to be a hybrid of No. 2 or 3 above with No. 1, and by others as a development direct from No. 3 or No. 1. The flowers are of various colors or part-colored, in an erect umbel on a scape much exceeding the long leaves. Often called *Polyanthus variabilis* in horticultural literature. April, May.

5. *P. Sinensis*, SABINE. CHINESE PRIMROSE. A soft-hairy, winter-blooming house plant from China, with soft, usually limp, long-petioled, deeply 7 to 9-lobed, and toothed leaves, and several erect scapes, each bearing an umbel of showy flowers, originally white or pale lilac, now of many colors, with salver-form corolla, the lobes obovate, and a large, loose calyx. Many varieties in cultivation. Jan. to March.

II. *DODECÂTHEON*, L. Smooth, perennial herbs, with fibrous roots, oblong or spatulate, radical leaves, an erect, simple, naked scape, and a terminal, involucrate umbel of showy flowers on slender, drooping pedicels, which become erect in fruit. Calyx 5-parted, segments lanceolate, reflexed. Corolla tube very short, limb 5-parted, segments long, narrow, and reflexed. Stamens 5, inserted on very short filaments in the throat of the corolla. Anthers large, acute, connivent in a slender cone. Style exserted. Capsule oblong-ovoid, 5-valved, many-seeded.

1. *D. Meadia*, L. SHOOTING STAR. AMERICAN COWSLIP. PRIDE OF OHIO. A remarkably handsome plant, of moist or dry cliffs or rocky soils and prairies from western Pa. to Minn. south to Ga. and Tex., with entire or repandly dentate leaves 7' to 10' long, and a scape 1° to 2° high, with an umbel of 9 to 20 rose-colored or white flowers, their wing-like, reflexed petals, beak-like, yellow anthers, and curving pedicels strik-

ingly suggestive of one of its common names. Highly ornamented in cultivation, more given to it abroad than at home. May, June.

III. TRIENTÀLIS, L. CHICKWEED WINTERGREEN. Low, smooth, perennial herbs, with filiform rootstock, erect, slender, simple stem, a few, small, scattered, scale-like leaves below, a whorl-like cluster of nearly sessile, conspicuous ones at the top, and one or more delicate, white or pink, star-shaped flowers on very slender peduncles. Calyx and corolla mostly 7 (6 to 8)-parted, spreading, flat. Stamens 7 (6 to 8). Capsule globose, 5-valved, many-seeded.

The only species besides the one below is *T. Europæa*, found in like latitudes from Europe to northeastern Asia and northwestern America, and characterized by *oblong-spatulate, obtuse leaves, and flowers often pink*.

1. T. Americana, Ph. STAR FLOWER. AMERICAN CHICKWEED WINTERGREEN. An interesting little plant, found in damp, cool woods from Me. to Minn. south to Va. and Ill., with stem 3' to 9' high, almost naked below, bearing at the top a cluster of 4 to 8 *unequal, thin, veiny, shining, sessile or short-petioled, narrowly lanceolate leaves, tapering at both ends, 3' to 4' long, and 1 to 3 slender-peduncled, star-shaped, white flowers*. Both this and *T. Europæa* are in ornamental cultivation. May, June.

IV. LYSIMÀCHIA, L. LOOSESTRIFE. Leafy-stemmed, mostly perennial herbs, widely distributed, with *entire*, often glandular-dotted leaves, and white, yellow, rose-colored, rarely purple or blue flowers, in our species yellow, of various inflorescence. Calyx and corolla mostly 5 to 6-parted; corolla rotate, segments entire, nearly or wholly distinct, convolute in bud. Stamens 5, more or less united at base, often unequal in length. Capsule globose, 5 to 10-valved, opening at the top. Seeds few or many.

1. L. stricta, Ait. BULB-BEARING LOOSESTRIFE. A smooth perennial, with erect, simple or branched stem, 1° to 2° high, *often producing oblong or moniliform bulblets in the axils after flowering*, common in low, wet grounds from Canada to Ga. and Ark. Leaves opposite, rarely alternate, lanceolate or oblong-lanceolate, acute at both ends, 1' to 3' long, sessile or nearly so, usually black-dotted. Flowers yellow, dotted or streaked with purple, 3'' to 5'' wide, on slender pedicels 5'' to 9'' long, in a bracted, terminal raceme 5' to 12' long, or 2 or 3 together in the upper axils. Filaments united at base, 2 long, 3 short. July to Sept.

2. L. quadrifolia, L. FOUR-LEAVED OR WHORLED LOOSESTRIFE. A somewhat hairy perennial, of moist or sandy soils from Canada to Ga. and Ky., with slender, erect, simple, rarely branched stem, 18' to 30' high, whorled, sessile leaves, usually in 4's, sometimes in 5's, rarely in 3's, 6's, or 2's, and yellow flowers on long, filiform, axillary, solitary peduncles. Leaves ovate-lanceolate or lanceolate, acute or acuminate, 2' to 4' long, usually dotted. Flowers 3'' to 6'' wide. Corolla and stamens as in No. 1. June to Aug.

3. L. Nummularia, L. MONEYWORT. CREEPING LOOSESTRIFE. A smooth, European perennial, common in rustic vases and hanging baskets,

somewhat escaped and naturalized in moist places from Me. to N.J., Pa., and Ind. Stems weak, trailing, creeping, often 2° long, and rooting at the nodes. Leaves opposite, short-petioled, small, roundish, subcordate, obtuse, and glossy. Flowers bright yellow, 8" to 12" wide, on solitary, axillary peduncles. The horticultural variety *aurea* has the leaves partly or wholly bright yellow. Called also *Herb Twopence*, *Creeping Jennie*, etc. A serviceable plant for carpeting the bare ground in shady places. June to Aug.

V. STEIRONEMA, RAF. Leafy-stemmed, perennial, North American herbs, sometimes included in *Lysimachia*, but specially distinguished from that genus by its 5 awl-shaped, *sterile filaments* or staminodia, whence its name (Steironema), between the fertile stamens. It differs also in having *dotless leaves*, *floral organs in 5's*, and each corolla segment convolute in bud around its stamen. Otherwise nearly as in *Lysimachia*.

1. S. ciliatum, RAF. (LYSIMACHIA CILIATA, L.) FRINGED LOOSE-STRIKE. A plant, mostly smooth, with erect, slender, 4-angled stem, 2° to 4° high, simple or with several, opposite branches, common in low, moist grounds and thickets, in gravelly soils, and near streams from Canada to Ga., Ala., and Neb. Leaves thin, opposite, upper ones sometimes apparently in 4's, ovate or ovate-lanceolate, 2' to 6' long, acute, with rounded or heart-shaped base, on long, *fringed petioles*, whence the specific name *ciliatum*. Flowers 6" to 12" wide, yellow, opposite, axillary, solitary, on nodding peduncles 6" to 24" long. June to Aug.

VI. ANAGALLIS, L. PIMPERNEL. Low, spreading or procumbent, mostly Old World and annual herbs, with angular stems, opposite or whorled, entire leaves, and solitary, peduncled, axillary flowers. Calyx 5-parted. Corolla rotate, deeply 5-parted, longer than the calyx. Stamens 5; filaments hairy. Capsule globular, thin, circumscissile, the top falling off like a lid. Seeds many.

1. A. arvensis, L. COMMON OR SCARLET PIMPERNEL. POOR MAN'S WEATHERGLASS. A European, procumbent, simple or branched annual, 6' to 20' long, naturalized in fields, by roadsides, and in waste places throughout our area, in Mexico, and on the Pacific Coast, with opposite, or rarely ternate, ovate, sessile leaves 6" to 10" long, and usually red flowers, sometimes blue, purple, or white, 2" to 3" wide, on slender peduncles longer than the leaves; opening only in fair weather and closing by 2 p.m. or on the approach of foul weather, hence one of its popular names. Petals obovate, obtuse, crenate-glandular. June to Aug.

ORDER 59. PLANTAGINACEÆ — PLANTAIN FAMILY

A family of fully 200 species widely distributed, but with the exception of two monotypic genera, *Littorælla* and *Bougueria*, the former a monœcious plant, the *Shore-*

weed, of northern lakes in Europe and America, and the latter a polygamous one confined to Peru ; they are all included in the one genus, *Plantago*, given below.

I. PLANTAGO, L. PLANTAIN. RIBWORT. Mostly stemless herbs, with radical, ribbed leaves, and inconspicuous, regular, spiked or capitate, perfect or polygamous flowers on scapes. Calyx of 4, or apparently 3, membranous, imbricated, persistent sepals. Corolla monapetalous, thin, scarious, withering on the fruit; border 4-toothed. Stamens 4, rarely 2, on the tube of the corolla, alternate with its lobes; filaments slender, usually exserted, sometimes included; anthers versatile. Ovary free, 2-celled, or falsely 3 to 4-celled; style 1, filiform; stigma long, hairy. Capsule membranous, 2-celled, 2 to several-seeded, opening by a lid, on the falling of which the loose partition and seeds also fall out.

1. P. major, L. COMMON OR GREATER PLANTAIN. A European, perennial weed, naturalized everywhere throughout our area around dwellings and by roadsides, with oval, oblong, or ovate, palmately 5 to 7-ribbed leaves on channeled petioles, and *short, cylindrical scapes 2' to 5' high*, each supporting its greenish or whitish *flowers in a long, dense spike 3 to 6 times as long as the scape*. Capsule ovoid, with 8 to 16 angled, reticulated seeds. Flowers appearing in succession all summer; and proterogynous, *i.e. the style projects before and the long-exserted stamens after the opening of the corolla*. The plant or a similar one is indigenous from Lake Superior northward, but that our weed is introduced from Europe is corroborated by the names *Englishman's Foot* and *White Man's Foot*, given to it by the Indians.

2. P. lanceolata, L. RIBGRASS. RIFFLEGRASS. ENGLISH PLANTAIN. A European, more or less perennial weed, naturalized throughout our area in fields, pastures, and grass lands, with narrowly lanceolate, 3 to 5-ribbed leaves, tapering into a channeled petiole, and *tall, angular scapes 9' to 20' high, bearing each its brownish flowers in a short, dense, ovate or at length cylindric spike 1' to 2' long*. Flowers proterogynous, as in No. 1. Capsules oblong. Seeds 2, hollowed on the face. May to Oct.

ORDER 60. BIGNONIACEÆ — TRUMPET-FLOWER FAMILY

Trees, shrubs, or rarely herbs, often twining or climbing, with exstipulate, usually opposite, mostly compound leaves, and showy, more or less irregular, monapetalous, 5-parted flowers in terminal or axillary clusters. Calyx inferior, 2-lipped. Corolla bell-shaped, funnel-shaped, or tubular, 5-lobed, somewhat 2-lipped or irregular. Stamens 2 or 4, often with 1 or 3 sterile filaments, inserted

on the corolla; anthers 2-celled. Ovary free, mostly 2-celled, with a fleshy disk beneath a long style and 2-lobed stigma. Capsule woody, 2-valved. Seeds few or many, large, flat, without albumen. Mostly tropical plants.

I. BIGNÔNIA, Tourn. Woody, American climbers, mostly tropical, with opposite, mostly compound leaves, usually terminating in a tendril, and large, showy flowers. Calyx bell-shaped, with truncate, undulate, or 5-toothed limb. Stamens didynamous, often with the sterile filament of a fifth, included. Capsule long and narrow, 2-celled; the valves flattened parallel with the partition. Seeds broadly winged laterally.

1. B. capreolata, L. CROSS-VINE. TENDRILED TRUMPET FLOWER. A woody, evergreen vine, of moist woods and rich soils from Va. to southern Ill. south to Fla. and La., with smooth, reddish-brown, slender stem, 30° to 50° long, climbing over bushes and up tall trees; the stem showing in a transverse section a distinct cross, the occasion of two of its common names *Cross-vine* and *Quarter-vine*. Leaves petioled, with a pair of lance-ovate or ovate, cordate, acuminate leaflets 3' to 7' long, and a terminal, branched *tendril*, whence its specific name *capreolata*. Peduncles 1' to 2' long, 2 or 3 together in the axils, each bearing a single red or orange flower, with tubular, bell-shaped corolla 2' long. Pod flat, 6' to 7' long, 8'' to 9'' wide. Seeds many, 18'' wide, with broad lateral wings, and narrow ones above and below. April to June.

II. TECOMA, Juss. Woody climbers, with aerial rootlets, or erect shrubs, sometimes trees, with evergreen or deciduous, opposite, odd-pinnate or digitately compound, sometimes simple leaves, and large, red, orange, yellow, or white flowers in terminal panicles, corymbs, or racemes. Calyx bell-shaped, 5-toothed. Corolla funnel-form, with dilated throat and slightly unequal, 5-lobed limb. Stamens 4, didynamous, with the rudiment of a fifth. Anther cells 2, diverging. Capsule elongated, 2-celled, 2-valved, the valves convex and at right angles to the partition. Seeds with broad, translucent, lateral wings.

1. T. radicans, Juss. TRUMPET FLOWER. TRUMPET CREEPER. A vigorous, woody vine, climbing by aerial rootlets as high as 20° to 40°, when finding support, otherwise prostrate, in moist woods and thickets and along rivers from southern N.J. and Pa. to Ill. south to Fla. and Tex., and often cultivated. Leaves petioled, odd-pinnate, 10' to 15' long; *leaflets* 7 to 11, ovate, acuminate, toothed, 2' to 3' long, dark green above, pale and *pubescent beneath*. Flowers on short pedicels in terminal corymbs, with orange and scarlet, tubular-funnel-form corolla, 30'' to 36'' long, and colored, *toothed calyx one third as long*. *Stamens included*. Pod oblongate, 4' to 6' long. Seeds many. June to Aug.

2. *T. grandiflora*, DELAUN. CHINESE TRUMPET FLOWER. A smooth, half-hardy, woody climber from China and Japan, with few aerial rootlets or none. Leaves odd-pinnate; leaflets 7 to 9, ovate-lanceolate, acuminate, serrate, smooth beneath, 18" to 30" long. Flowers in terminal racemes or panicles, with rich scarlet, bell-shaped corolla 2' wide, the tube little, if any, longer than the calyx, cleft to the middle. July.

3. *T. Capensis*, LINDL. CAPE HONEYSUCKLE. A smooth, greenhouse climber from the Cape of Good Hope (Capensis), with the orange-scarlet flowers in dense, peduncled, terminal racemes. Leaves odd-pinnate; leaflets 7 to 9, roundish-ovate, acute, coarsely serrate, 2' long. Corolla long-tubular, incurved, 2' long, with a 4-parted limb and exerted stamens and style.

III. *CATÁLPA*, SCOP. *CATALPA*. INDIAN BEAN. Trees, with opposite or rarely ternately-whorled, simple, petioled leaves, and large, handsome flowers in large, terminal panicles. Calyx 2-parted. Corolla bell-shaped, with inflated tube and irregularly spreading, 5-lobed, 2-lipped limb. Stamens 2, fertile, sometimes 4; the other 3 or 1 rudimentary. Capsule linear, nearly cylindrical, very long, slender, 2-celled, the valves at right angles to the partition. Seeds flat, with large, lateral, fringed wings.

1. *C. bignonioides*, WALT. COMMON *CATALPA*. A large tree, 40° to 60° high, native in the Southern States, but extensively cultivated and escaped as far north as Pa. and N.Y., with usually a short, thick trunk, widely spreading branches, thin, flaky, light-brown bark, broadly ovate-cordate, acuminate, ill-scented leaves 6' to 12' long, pubescent beneath, on stout petioles, and a great profusion of many-flowered, erect, thyrsoid panicles 8' to 10' long. Flowers white, 12" to 18" long, mottled within with yellow and violet spots. Pods 10' to 12' long, 4" to 5" thick. June, July.

2. *C. speciosa*, WARDER. *CATAWBA TREE*. A tree, of rich woodlands from southern Ind., Ill., and Mo. to Tenn. and Ark., and also cultivated, similar to the preceding, possibly a mere variety, but much larger, with thick, rough bark, leaves not ill-scented, the panicles few-flowered, corolla little mottled within, and the pods longer and thicker, 10' to 20' long, 8" to 10" thick. May, June.

ORDER 61. LOGANIACEÆ — LOGANIA FAMILY

Herbs, shrubs, or, within the tropics, trees, some climbing, with opposite, sometimes whorled, entire, simple leaves, stipules or stipular lines or membranes between the petioles, and regular, perfect, 4 to 5-parted, monopetalous flowers of various colors and inflorescence. Calyx inferior. Stamens 4 to 5, inserted on the tube or throat of the corolla, alternate with its lobes. Style 1; stigmas as many as the cells of the free ovary. Fruit a 2-celled,

many-seeded capsule, as in our species, or a berry, or a drupe. Seeds albuminous.

The family resembling and sometimes appended to *Rubiaceæ*, is separated from it by its free ovary, and is closely related also to *Apocynaceæ*, *Gentianaceæ*, and *Scrophulariaceæ*. It belongs chiefly to warm and tropical regions with generally poisonous properties, *Strychnos Nux-Vômica*, an East Indian tree yielding strychnine, and two other species of Guiana and Java respectively furnishing the natives with deadly poisons for their arrows.

Key to Genera

Woody vines. Corolla funnel-form	GELSEMIUM I
Herbs. Corolla tubular	SPIGELIA II

I. GELSEMIUM, Juss. Smooth, woody, twining plants, with thin, opposite leaves, their petioles connected by a transverse, stipular line, and large, yellow flowers in small, axillary or terminal cymes. Calyx 5-parted. Corolla funnel-form, with 5 short, rounded lobes, imbricated in the bud. Stamens 5, on the tube of the corolla; anthers sagittate. Style long, filiform; stigmas 2, each 2-parted; ovary 2-celled. Pod oval, septically 2-valved, each valve 2-cleft at the top, flattened contrary to the partition. Seeds several in each cell, winged.

A Chinese species with flowers in terminal cymes is the only one known besides the one below.

1. G. sempervirens, Ait. YELLOW JESSAMINE. CAROLINA OR FALSE JASMINE. A handsome, woody vine, common in low grounds, woods, and thickets, and on banks of streams from eastern Va., mostly near the coast, to Fla. and Tex., with smooth, slender stem, sometimes 20° long, trailing on the ground or climbing over bushes and low trees, and with shining, coriaceous, evergreen, lanceolate to ovate, short-petioled leaves 2' to 3' long, and numerous, golden-yellow, fragrant, *dimorphous* flowers on short, scaly-bracted pedicels in axillary clusters. Corolla 12" to 18" long. March to May.

II. SPIGELIA, L. American herbs, rarely somewhat shrubby, with opposite, entire leaves, and small or elongated, red, yellow, or purplish flowers, usually in 1-sided spikes. Calyx 5-parted; lobes narrow. Corolla tubular, 5-lobed, valvate in bud. Stamens 5, on the tube of the corolla. Capsule flattened contrary to the partition, 2-celled, twin. Seeds few, wingless.

1. S. Marilandica, L. INDIAN OR CAROLINA PINK. A handsome, dark-green herb, of rich woods, from N.J. to Ill. south to Fla. and Tex., with slender, erect, 4-angled, tufted stems, 6' to 18' high, mostly simple and smooth, from a perennial root, thin, ovate-lanceolate, acute, sessile, opposite leaves 3' to 4' long, and a short, simple, or forked spike of 3 to 8 scarlet and yellow flowers. Corolla somewhat club-shaped, 18" to 24" long, scarlet without, yellow within; lobes lanceolate; tube 4 times as long as the calyx. A well-known anthelmintic, called also *Worm Grass* and *Pinkroot*, often cultivated for ornament. May to July.

ORDER 62. SCROPHULARIACEÆ — FIGWORT FAMILY

Herbs, rarely shrubs or small trees, with alternate or opposite, exstipulate leaves, and perfect, irregular, monopetalous flowers in axillary or terminal racemes or panicles. Calyx free, persistent, of 5, rarely 4, teeth or lobes. Corolla with 2-lipped or nearly regular limb, the lobes imbricated in the bud. Stamens inserted in the tube of the corolla, usually didynamous, often only 2, rarely 5 perfect, 1 or 3 usually sterile or rudimentary. Ovary free, 2-celled, style 1, stigma 2-lobed. Fruit a 2-celled, many-seeded capsule, with axile placentæ and albuminous seeds. A large family widely distributed.

Key to Genera

- | | | |
|--|---------------------|------|
| 1. Exotic trees, with violet flowers in large, terminal panicles . . . | PAULOWNIA | VII |
| 1. Herbs. (2) | | |
| 2. Corolla somewhat regular, not strikingly 2-lipped. (3) | | |
| 2. Corolla decidedly irregular and strikingly 2-lipped. (5) | | |
| 3. Corolla rotate. Stamens 5, perfect . . . | VERBASCUM | I |
| 3. Corolla rotate, rarely tubular. Stamens 2, perfect . . . | VERONICA | X |
| 3. Corolla tubular, bell-shaped or funnel-form. Stamens 4, perfect. (4) | | |
| 4. Leaves alternate. Flowers in a long, terminal raceme . . . | DIGITALIS | IX |
| 4. Leaves mostly opposite. Flowers yellow . . . | DASYSTOMA | XI |
| 4. Leaves mostly opposite and slender. Flowers mostly purple . . . | GERARDIA | XII |
| 5. Corolla spurred at the base. Stamens 4 . . . | LINARIA | II |
| 5. Corolla saccate at the base. Stamens 4 . . . | ANTIRRHINUM | III |
| 5. Corolla neither spurred nor saccate. Perfect stamens 4. (6) | | |
| 6. A fifth distinct filament, as long as the others, often bearded . . . | PENTSTEMON | VI |
| 6. A fifth distinct filament, shorter than the others and smooth . . . | CHELONE | V |
| 6. A fifth filament represented by a distinct scale . . . | SCROPHULARIA | IV |
| 6. No fifth filament, or minute. (7) | | |
| 7. Leaves opposite. Calyx prismatic, 5-angled . . . | MIMULUS | VIII |
| 7. Leaves opposite. Calyx bell-shaped, 4-cleft . . . | MELAMPYRUM | XV |
| 7. Leaves alternate. Leafy bracts conspicuously colored . . . | CASTILLEJA | XIII |
| 7. Leaves mostly alternate. Leafy bracts not colored . . . | PEDICULARIS | XIV |

I. VERBÁSCUM, L. MULLEIN. Old World herbs, mostly biennial and woolly, tall and erect, with coarse, alternate leaves, stem ones sessile or decurrent, and yellow, brown, red, purple, or rarely white flowers in terminal spikes, racemes, or panicles. Calyx 5-parted. Corolla rotate; lobes 5, broad, rounded, slightly unequal. Stamens 5, perfect; filaments, at least the 3 upper, woolly. Capsule ovoid or globose, many-seeded.

Leaves decurrent. Flowers yellow, in a long, thick spike . . .	No. 1
Leaves not decurrent. Flowers white, yellow, or purple, in racemes . . .	No. 2

1. **V. Thápsus**, L. **COMMON MULLEIN**. A European weed, densely woolly throughout, naturalized and common in fields and waste places from Me. to Minn. south to Fla. and Kan., with a simple, stout, tall, and upright stem, 2° to 6° high, winged by the decurrent, oblong, acute leaves, and a dense, elongated, terminal spike, sometimes several spikes, of yellow, rarely white flowers 8'' to 12'' wide, the 3 upper stamens woolly, the 2 lower smooth.

Though regarded generally as a homely and useless weed, it is nevertheless interesting, as evinced by its numerous names, some of them indicating uses dating back to Greek and Roman times. Native also of Asia. Of more than twenty English, common names are *Bullock's Lungwort*, *Hig-taper*, *Hag-taper*, *Candlestick*, *Adam's Flannel*, *Velvet Dock*, etc. June to Sept.

2. **V. Blattaria**, L. **MOTH MULLEIN**. A European weed, naturalized as extensively as No. 1, with a slender, erect, smoothish, usually simple stem, 1° to 3° high, oblong, ovate, or lanceolate, dentate, smooth leaves, upper ones sessile or clasping, lower ones petioled, and a loose raceme 1° to 2° long, of yellow or white and purple-tinged flowers 10'' to 12'' wide, on spreading pedicels 6'' to 12'' long, the unequal stamens all clothed with violet wool. Capsule depressed-globular, exceeding the calyx. Called *Moth Mullein* from its being frequented by moths. So also *Blattaria*, its old Latin name, from *blatta*, a moth. June to Nov.

II. LINARIA, JUSS. **TOADFLAX**. Low herbs, sometimes somewhat shrubby, mostly Old World and extra-tropical, with alternate, opposite, or whorled leaves, and yellow, white, blue, or purple flowers, solitary and axillary, or in terminal spikes or racemes. Calyx 5-parted. *Corolla personate; upper lip exterior in the bud, 2-lobed, reflexed; lower lip 3-lobed, with a prominent palate often closing the throat; tube inflated, spurred at the base*. Stamens 4, didynamous, included, ascending in pairs. Capsule opening by slits or pores near the top.

1. **L. vulgaris**, MILL. **YELLOW TOADFLAX**. **BUTTER AND EGGS**. A pale green, somewhat glaucous, Old World perennial, widely naturalized in temperate regions and a very common weed from Canada to Va. and Neb., with a short rootstock, underground runners, and slender, erect, smooth, very leafy stems, 1° to 2° high, terminating in very showy, dense, spicate racemes of light yellow and orange flowers. Leaves sessile, linear or nearly so, entire, 9'' to 18'' long. Corolla 10'' to 15'' long, with throat closed by the orange-colored palate; spur slender, awl-shaped. Under cultivation, rarely in its wild forms, an abnormal return to regularity and symmetry, called the "*Peloria state*," occurs in this species, in which there are 5 spurs or none, and a regular, 5-lobed limb. June to Oct.

2. **L. Canadensis**, DUMONT. **BLUE OR AMERICAN TOADFLAX**. A smooth, green biennial or annual, common in dry soils throughout our area, with slender, erect or ascending, nearly simple stems, 6' to 24' high, scattered, linear leaves 6'' to 12'' long, and small, blue or violet flowers 3'' to 4'' long, in loose, terminal racemes. Pedicels erect, not longer than the curved spur of the corolla. Throat closed by the whitish palate. Scions procumbent. June to Sept.

3. **L. Cymbalaria**, MILL. **KENILWORTH IVY**. A smooth and delicate, little, trailing perennial from Europe, often cultivated in hanging baskets or in odd corners of greenhouses, with rooting branches, mostly alternate, cordate-orbicular, or reniform, 5 to 7-lobed leaves on slender petioles, and

pale blue flowers with yellowish throat and short spur, on slender, axillary peduncles. One variety has white flowers; another, variegated leaves. Called also *Ivy-leaved Toadflax* and *Mother of Thousands*. A continuous bloomer from spring to autumn.

4. *L. triornithophora*, WILLD. **THREE BIRDS**. A curious, smooth, glaucous perennial from Spain and Portugal, 2° to 3° high, with ovate-lanceolate, acute leaves, in 3's and 4's, and slender-peduncled, purple flowers 1' long, with orange palate and long spur, usually in whorls of 3, suggestive of the common and specific names, the latter signifying *bearing three birds*. June to Sept.

III. ANTIRRHINUM, L. SNAPDRAGON. Chiefly Old World, annual or perennial herbs, rarely shrubs, of warm and temperate regions, with lower leaves usually opposite, upper alternate, and flowers in terminal racemes, or axillary and solitary, with red, purple, yellow, or white, *personate corolla, distinguished from that of Linaria by its saccate or gibbous base without a spur*. Calyx 5-parted or 5-sepaled. Corolla with throat closed by prominent palate; upper lip bifid, reflexed; lower trifid. Stamens and capsule as in *Linaria*.

1. *A. majus*, L. **COMMON OR LARGE SNAPDRAGON**. A common, garden perennial from Europe, somewhat escaped to roadsides in the Atlantic States, with simple or branched stem, 1° to 3° high, smooth below, glandular downy in the raceme. Leaves smooth, lanceolate or oblong, acute at each end, entire, 1' to 3' long, on short petioles. Flowers 12" to 18" long, ranging in color from purplish-red, with yellow palate, to scarlet, pink, and white, with long tube and spreading, irregular lobes, on stout pedicels in a long, terminal raceme. Double forms occur. June to Sept.

IV. SCROPHULARIA, L. FIGWORT. Chiefly rank and homely, perennial, extra-tropical herbs, of the northern hemisphere, mostly European, with usually large and opposite leaves and small, inconspicuous, greenish-purple or yellow flowers in loose cymes in a terminal panicle. *Flowers proterogynous, i.e. pistils maturing before the stamens*. Calyx 5-parted. Corolla irregular; tube ventricous, subglobose, or oblong; limb with 2 erect lobes longer than the 2 lateral, ascending, and the 1 lower, spreading or reflexed ones. Stamens 4, perfect, didynamous, with a scale-like rudiment of a fifth in the throat. Capsule ovoid.

1. *S. nodosa*, L., Var. *Marilandica*, GRAY. **COMMON FIGWORT**. A smooth perennial, of woods and thickets from N.Y. to Kan. south to Va. and Tenn., or perhaps to Fla. and Tex., with slender, 4-angled and grooved, erect, widely branched stem, 3° to 6° high, smooth, thin, ovate, ovate-oblong, or lanceolate, acute, serrate leaves, narrowed, rounded, truncate or subcordate at base, 3' to 7' long, on rather long, slender petioles and numerous greenish-purple flowers 3" to 4" long, in a long narrow, terminal, thyrsoid panicle. *Bractlets mostly opposite. Corolla dull*

green outside, shining, brownish-purple within. Sterile stamen deep purple. June to Oct.

2. *S. leporélla*, BICKNELL. HARE FIGWORT. A plant of woods and roadsides from Conn. to Minn. south to Va. and Neb., possibly farther south, similar to No. 1, but with the stem viscid-glandular above and not grooved, mostly simple or little branched, the leaves short-petioled and coarsely toothed, and the flowers 4" to 5" long, with corolla shining green and purple outside and dull within. The sterile stamen greenish-yellow. Bractlets usually alternate. May to July.

V. *CHELONE*, L. TURTLEHEAD. SNAKEHEAD. Smooth, perennial, North American herbs, nearly allied to *Pentstemon*, with erect, simple or branched stem, opposite, sharply serrate or dentate leaves, and large, white, purple or purplish flowers, in dense terminal or axillary spikes, or, in the Pacific Coast species, in a loose panicle. Calyx of 5 imbricated sepals with 3 bracts at the base. Corolla inflated-tubular, 2-lipped, the mouth slightly open; upper lip concave, notched or entire exterior in the bud; lower 3-lobed, spreading, woolly in the throat. Stamens included, 4 perfect, didynamous, with woolly filaments, and woolly, heart-shaped anthers; a fifth filament smooth, shorter, abortive. Pod ovoid. Seeds flattened, winged.

4 species, 3 of eastern and 1 of western North America.

1. *C. glabra*, L. A common plant by brooks and in wet places throughout our area, with mostly simple stem, 1° to 3° high, dark green, oblong-lanceolate, acuminate leaves 3' to 6' long, with low, appressed, sharp teeth, the base usually narrowed to a very short petiole, and white or pinkish flowers, 1' long, in a dense spike, with the bracts glabrous, i.e. not fringed as in the other two eastern species. The generic and vernacular names refer to the shape of the corolla. Aug., Sept.

VI. *PENTSTEMON*, L. PENTSTEMON. BEARD TONGUE. Herbaceous, rarely somewhat shrubby perennials, with one exception all North American, with simple stems, or branched only from the base, mostly opposite leaves, and usually showy, purple, blue, red, or white flowers in terminal thyrses, panicles, or racemes. Calyx 5-parted. Corolla with elongated, more or less inflated tube, 2-lobed upper and 3-lobed lower lip. Stamens 5, included, 4 perfect, didynamous, the fifth sterile, but conspicuous, about as long as the others and often bearded, whence the botanical and common names above. Stigma capitate. Seeds wingless.

Except one in northeastern Asia and several in the cooler parts of Mexico, all the species, about 100, many of them in ornamental cultivation, belong to the U.S. and Canada.

1. *P. pubescens*, SOLANDER. HAIRY PENTSTEMON OR BEARD TONGUE. A more or less pubescent plant, with slender, erect stem, 1° to 2° high, common on banks, bluffs, and on dry or rocky ground throughout our

area, and often cultivated. Leaves denticulate or entire, 2' to 4' long, radical ones ovate or oblong, petioled; upper, cauline ones opposite, lanceolate, sessile or somewhat clasping. Flowers 1' long, in a narrow, loose, thyrsoïd, glandular-pubescent panicle, on peduncles 2' to 3' long, and pedicels 9'' to 12'' long. Corolla bluish-purple or partly whitish; tube gradually and moderately dilated; throat nearly closed by the bearded palate. *Sterile filament densely bearded on its upper half.* May to July.

2. *P. lævigatus*, SOLANDER. SMOOTH PENTSTEMON OR BEARD TONGUE. A smooth, more or less glaucous plant, of rich or moist soils in woods and thickets from Pa. to Fla. west to Ky. and La., with tall, slender stem, 2° to 3° high, smooth up to the glandular inflorescence. Leaves denticulate, 2' to 5' long, rather firm, purplish, and glossy; lower and radical ones oval or oblong, obtuse, narrowed into a winged petiole; upper cauline, ovate-lanceolate, sessile or somewhat clasping. Flowers pale blue to white, in a loose, thyrsoïd panicle broader than in No. 1, on very short pedicels or sessile. *Corolla 8'' to 12'' long; tube gradually and widely dilated to funnel-form; throat wide open, beardless. Sterile filament thinly bearded.* May to July.

3. *P. Digitalis*, NUTT. FOXGLOVE PENTSTEMON OR BEARD TONGUE. A species similar to No. 2, by some regarded as a mere variety of it, occurring in rich soils from Pa. westward to Iowa, Mo., and Ark., or still farther south, with a rather stout stem, 4° to 5° high, smooth up to the glandular inflorescence. Flowers larger than in No. 2, on pedicels 1'' to 3'' long. Corolla nearly or entirely white, 12'' to 15'' long; *the tube abruptly and widely dilated to bell-shaped; throat open, beardless. Sterile filament thinly bearded.* June, July.

4. *P. barbatus*, NUTT. BEARDED PENTSTEMON OR BEARD TONGUE. A smooth, somewhat glaucous and showy plant, of Mexico and Col., long common in gardens, with slender, erect stems, 3° to 4° high, pale, firm, entire, sessile, lanceolate to linear leaves, radical ones oblanceolate to spatulate, and light pink to scarlet, drooping flowers, on 2 to 3-flowered peduncles, in a narrow, loose panicle. *Corolla tubular, slender, 12'' to 18'' long, with bearded (barbatus) throat, erect, concave, somewhat 2-lobed upper lip, and the lower of 3 reflexed, oblong lobes. Sterile filament beardless, or sometimes bearded (?).*

5. *P. grandiflorus*, NUTT. LARGE-FLOWERED PENTSTEMON OR BEARD TONGUE. A smooth and very glaucous plant, of the prairies from Wis. to Minn. and S. Dak. to Ill. and Kan., and often cultivated, with stout stem, 2° to 4° high, and thick, entire, broad, obtuse leaves 1' to 2' long; radical ones obovate, petioled; lower cauline, broadly ovate or oval and sessile; upper and floral nearly orbicular and clasping. Flowers on short pedicels in a raceme-like, leafy-bracted thyrses. *Corolla 18'' to 24'' long, lilac-purple, oblong-bell-shaped, with slightly 2-lipped, almost equally 5-lobed limb. Sterile filament naked, with a minutely bearded hook at the top.* June to Aug.

VII. PAULOWNIA, SIEB. AND ZUCC. Chinese and Japanese trees, with spreading branches, large, opposite leaves, and showy flowers in terminal panicles. Calyx bell-shaped, 5-lobed. Corolla tubular, elongated, slightly curved, dilated above, with 5-lobed, spreading, oblique limb. Stamens 4, didynamous, included. Capsule ovoid, opening loculicidally; seeds small, winged.

Three species now known, the third reported a magnificent evergreen of southern China.

1. *P. imperialis*, SIEB. AND ZUCC. (*P. tomentosa*, BAILL.) A handsome, ornamental, half-hardy tree, somewhat escaped from cultivation in southern N.Y., N.J., and southward, resembling the Catalpa in habit and foliage, with stout, spreading branches, broadly ovate-cordate, entire, or sometimes 3-lobed, dull green leaves, downy above, tomentous beneath, on long petioles, and fragrant, pale violet flowers 24" to 30" long, on stout pedicels, in erect, terminal panicles 6' to 10' long, opening before the leaves. Calyx and pedicels rusty-woolly. Pod ovoid, pointed, 1' to 2' long. April to June.

VIII. MIMULUS, L. MONKEY FLOWER. Erect or decumbent herbs, rarely shrubby, with opposite, simple, entire or toothed leaves, and usually showy flowers, solitary and axillary, or becoming racemed by the change of the upper leaves to bracts. Calyx prismatic, 5-angled, 5-toothed. Corolla tubular, limb 2-lipped, upper lip with 2 erect or reflexed lobes, lower with 3 spreading ones. Stamens 4, didynamous. Stigma 2-lobed. Capsule oblong or linear, opening loculicidally.

Widely distributed in extra-tropical countries; but totally absent from Europe and the whole Mediterranean region.

1. *M. ringens*, L. **SQUARE-STEMMED MONKEY FLOWER.** A perennial herb, common in wet and muddy places along ditches and small streams from Me. to Minn. south to Va., Tenn., and Tex., with erect, smooth, square stem, 2° to 3° high, pinnately veined, lanceolate, acute, serrate, sessile or clasping leaves 2' to 4' long, and solitary, blue or violet, rarely white flowers 12" to 18" long, on slender, axillary peduncles *longer than the flower*. Corolla yellow within, the lips ringent, but the throat closed. Calyx tube nearly as long as that of the corolla, *the teeth long and tapering*. July to Sept.

2. *M. alatus*, AIT. **WINGED MONKEY FLOWER.** A plant ranging from Conn. to Ill. south to Ga. and Tex. Similar to the preceding in habitat, size, and most other characteristics, but most clearly distinguished from it by having the *stem slightly winged at the corners*, the *leaves tapering at base to a petiole*, the *peduncles shorter than the calyx*, and the *teeth of the calyx short and abruptly pointed*. Leaves ovate. July to Sept.

IX. DIGITALIS, L. FOXGLOVE. Old World, biennial or perennial herbs, with erect, usually simple stems, alternate, toothed or entire leaves, and large, purple, yellowish, or white, drooping flowers, in a long, terminal, sometimes one-sided raceme. Calyx 5-parted, segments unequal. Corolla obliquely bell-shaped, with short, obliquely 4-lobed limb, the upper lobe notched. Stamens 4, didynamous. Pod ovoid, opening septically.

1. *D. purpurea*, L. **COMMON OR PURPLE FOXGLOVE.** An ornamental, pubescent, European biennial or perennial, very common in gardens, with erect, stout stem, 2° to 4° high, oblong, rugose, crenate leaves, radical and lower ones 6' to 10' long, and petioled, upper ones smaller and sessile, and

numerous, drooping flowers 2' long, purple, varying to white, spotted within, in a dense, terminal raceme 10' to 15' long. July to Aug.

One of the commonest of English wild flowers. The dried leaves furnish the *digitalis* of pharmacy. July, Aug.

X. VERÓNICA, L. SPEEDWELL. Herbs in all north temperate regions, elsewhere sometimes shrubs or trees, with opposite, rarely whorled or alternate leaves, and usually small, blue, purple, rose-colored, or white flowers, in bracted, terminal or axillary racemes or spikes, or rarely solitary in the axils of alternate leaves. Calyx usually 4 to 5-parted. Corolla rotate, except in No. 1 below, 4-parted, rarely 5-parted, the upper lobe usually wider than the others. Stamens 2, divergent, exserted, one on each side of the upper lobe of the corolla. Style slender. Stigma capitate. Capsule, except in No. 1 below, more or less flattened, obtuse, notched, or obcordate. Seeds few or many.

§ **LEPTÁNDRA.** Very tall! Leaves whorled. Flowers tubular, in terminal spikes No. 1
 § **VERONICA** proper. Low. Cor. rotate. Fls. racemed, terminal or axillary Nos. 2 to 5
 — Low. Cor. rotate. Fls. solitary, in axils of alternate, upper leaves Nos. 6, 7

1. V. Virginica, L. (LEPTÁNDRA VIRGINICA, NUTT.) CULVER'S ROOT. GREAT VIRGINIA SPEEDWELL. A conspicuous and handsome, perennial herb, with a tall, upright, simple, smooth stem, 3° to 6° high, lance-ovate to lance-linear, finely serrate, short-petioled leaves 3' to 6' long, in whorls of 3 to 6, and usually several, terminal, dense, spicate racemes 3' to 8' long, of white, sometimes pale blue or purple flowers, with *tubular corollas* and *long-exserted stamens and style*, growing in meadows and moist banks and woods from Me. to Minn. south to Ga., Ala., Mo., and Kan., and sometimes cultivated, having been introduced into English gardens in 1714. Native also of Japan and eastern Siberia. June to Aug.

2. V. Anagallis, L. WATER SPEEDWELL. LESSER BROOKLIME. A smooth, fleshy, creeping perennial, of the borders of brooks and ditches from New Eng. to N.J. west to the Rockies and south to the mts. of N.C., with erect or decumbent branches, opposite, sessile or clasping, and subcordate, lanceolate, acute, serrate or entire leaves 2' to 3' long, and opposite, loose, axillary racemes of pale blue, purple-striped flowers. Capsules *roundish, turgid*, notched. Found also in Great Britain, Europe, and Asia. June, July.

3. V. Americana, SCHWEINITZ. AMERICAN BROOKLIME. A smooth perennial, decumbent and rooting at base, erect above, 8' to 12' high, with ovate or ovate-oblong, acute or obtusish, serrate, mostly petioled leaves 1' to 2' long, and flowers, racemes, and pods nearly as in No. 2, common in or along brooks and ditches from New Eng. to Neb. south to Pa. and Ohio. June to Aug.

4. V. officinalis, L. COMMON SPEEDWELL. A roughish-pubescent, trailing perennial, of dry hills, open woods and fields from New Eng. to Mich. south to the mts. of N.C. and Tenn., also in Europe and Asia, with prostrate stem and ascending branches 6' to 12' long, short-petioled or subsessile, obovate-elliptic or wedge-oblong, obtuse, serrate leaves 1' to 2' long, and dense, spike-like, axillary, peduncled, erect racemes, *often only*

in alternate axils, of pale blue flowers, succeeded by flattened, obovate-triangular, slightly notched capsules. May to Sept.

5. *V. serpyllifolia*, L. THYME-LEAVED SPEEDWELL. A nearly smooth perennial, common in fields, in grass by roadsides, etc., native and introduced, from Canada to Ga., as also in Europe, Asia, and South America, with slender, decumbent stems, much branched below, the branches ascending or erect, 3' to 8' high, opposite, oval, ovate or oblong, obtuse, subcrenate leaves 3" to 12" long, the lower rounded and petioled, the upper sessile, passing into alternate, lanceolate, entire bracts, and terminal, bracted racemes of pale blue or white, purple-striped flowers, succeeded by *flat, broad, obcordate capsules*; the *racemes elongating and becoming loose in fruit. May to Aug.*

6. *V. peregrina*, L. NECKWEED. PURSLANE SPEEDWELL. A nearly smooth or glandular-pubescent annual, with erect, simple or branched stem, 4' to 10' high, common in damp soils of waste or cultivated grounds everywhere in North America, and distributed as a weed in the Old World, with the lowest leaves opposite, oval-oblong, petioled, toothed, thickish, upper, sessile, *floral ones alternate*, oblong-linear, entire, *longer than the pale blue or whitish flowers in their axils.* Sepals exceeding the corolla. Capsule orbicular, notched, many-seeded. April to July.

7. *V. arvensis*, L. CORN SPEEDWELL. A small, downy, pale green annual, 3' to 8' high, naturalized from Europe and common in dry fields, woods, waste places, and cultivated grounds from Me. to Minn. south to Fla. and Tex., similar to No. 6, but *pubescent*, and with the *leaves ovate or round-ovate, subcordate, incisely crenate*, the lower petiolate, the upper alternate, sessile, ovate or lanceolate, crenate or entire. Flowers pale blue, *pencilled with darker lines.* Capsule obcordate. May to June.

XI. DASÝSTOMA, RAF. FALSE OR YELLOW FOXGLOVE.

Large annual or perennial herbs, of eastern North America, sometimes included in *Gerardia*, partly parasitic on the roots of other plants, with erect, simple or branched stems, mostly opposite leaves, and large, showy, yellow flowers in terminal, usually leafy-bracted racemes or panicles. Calyx 5-toothed or -cleft. Corolla bell-shaped to funnel-shaped, woolly within; tube longer than the 5 rounded, entire, spreading lobes. Stamens 4, didynamous, included or nearly so; filaments and anthers woolly, the latter awned at the base. Capsule ovoid, acute, exceeding the calyx, the 2 valves bearing the partition in the middle. Seeds many.

Calyx segments entire. Plants pubescent	.	.	.	.	.	.	.	No. 1, 2
Calyx segments entire. Plants smooth	.	.	.	.	.	.	.	No. 3, 4
Calyx segments toothed or pinnatifid. Plants downy	.	.	.	.	.	.	.	No. 5

1. *D. flava*, WOOD. (*D. PUBÉSCENS*, BENTH.) DOWNY FALSE OR YELLOW FOXGLOVE. A grayish, downy perennial, with upright, nearly simple stem, 2° to 4° high, common in dry, open woods from New Eng. to Minn. south to Fla. and Ark. Leaves nearly sessile, oblong-lanceolate, obtuse, entire or toothed, or the lower sinuate-toothed or pinnatifid, 3' to 6' long. Calyx lobes oblong, obtuse, shorter than the tube, and longer than the stout pedicels. Corolla 18" long, smooth outside. July, Aug.

2. *D. grandiflora*, WOOD. WESTERN FALSE OR YELLOW FOX-GLOVE. A minutely pubescent, much branched perennial, 2° to 4° high, of prairies, barrens, and dry woods from Wis. to Minn. south to Tenn. and Tex., with petioled, lance-ovate, pinnatifid or deeply incised leaves 2' to 4' long, upper ones sessile, and flowers 2' long; the corolla 4 times as long as the pedicels or the entire or toothed calyx lobes. July, Aug.

3. *D. integrifolia*, WOOD. (*D. LÆVIGATA*, RAF.) ENTIRE-LEAVED FALSE OR YELLOW FOXGLOVE. A smooth, not glaucous perennial, of dry woods from Pa. to Mich. and Ill. south to Ga. and Tenn., with simple or sparingly branched stem, 1° to 2° high, lanceolate, acute leaves 1' to 3' long, entire or nearly so, and flowers about 1' long. July, Aug.

4. *D. quercifolia*, BENTH. (*D. VIRGINICA*, BRITTON.) SMOOTH FALSE OR YELLOW FOXGLOVE. A smooth and glaucous perennial, with rather stout, purplish, usually branching stem, 3° to 6° high, common in dry woods from Me. to Minn. south to Fla. and Ill. Leaves petioled, lower bipinnatifid, 3' to 5' long, upper oblong-lanceolate, pinnatifid or entire. Flowers 2' long, on pedicels nearly as long as the calyx. Aug.

5. *D. Pedicularia*, BENTH. FERN-LEAVED OR LOUSEWORT FALSE OR YELLOW FOXGLOVE. A common, smoothish or glandular-pubescent and viscid annual or biennial, of dry woods and copses from Canada to Fla. and Ark., with a bushy, very leafy stem, 2° to 3° high, and ovate-lanceolate, pinnatifid leaves 1' to 3' long, the segments toothed or incised. Corolla 15'' long, pubescent outside. Pedicels longer than the hairy calyx, with its oblong, toothed, or pinnatifid, leafy lobes. July, Aug.

XII. GERÁRDIA, L. GERARDIA. Erect, branching, American herbs, rarely somewhat shrubby, with mostly opposite and sessile, often narrow, linear or filiform leaves, and usually purple or rose-colored, rarely white flowers in racemes or panicles, or solitary and axillary. Calyx bell-shaped, 5-toothed. Corolla tubular, inflated, bell-shaped or funnel-form, with 5-lobed limb. Stamens 4, didynamous, included. Capsule obtuse or pointed. Seeds many.

Leaves linear, entire Nos. 1 to 3
Leaves ovate-lanceolate to lanceolate, auricled No. 4

1. *G. purpurea*, L. LARGE PURPLE GERARDIA. A smooth annual, of moist fields and meadows or other low, wet grounds from New Eng. to Fla. and La., mainly near the coast, also near the Great Lakes, with slender, angular stem, 1° to 2°, or in the South, 2° to 4° high, with long, stiff, ascending or widely spreading branches, linear, acute, rough-edged leaves 1' to 2' long, often with smaller ones clustered in the axils, and bright purple, rarely white flowers 1' long, on opposite pedicels shorter than the calyx. Corolla inflated above, smooth or pubescent within. Calyx teeth acute, from very short to half the length of the tube. Very variable. Var. *fasciculata*, CHAPM., of low grounds near the coast from S.C. to Fla., has a stem 3° to 5° high, leaves rough on both sides and clustered, the uppermost, as well as the flowers, alternate. Aug. to Oct.

2. *G. paupercula*, BRITTON. SMALL-FLOWERED GERARDIA. A species found in low, wet grounds from New Eng. to N.J. and Pa. west to northern Ill. and Minn., similar to No. 1, and regarded by some as a mere variety, but a smoother and more simple plant, with smaller leaves 6'' to 12'' long, and lighter, rose-purple flowers 6'' long. July to Sept.

3. *G. tenuifolia*, VAHL. **SLENDER GERARDIA**. A smooth annual, common in light soils of fields or woods from New Eng. to Ill. south to Ga. and La., with very slender, paniculately much-branched stem, 6' to 18' high, very narrow, linear, acute leaves 10" to 15" long, and bright purple flowers, opposite and axillary, on *filiform pedicels as long as the leaves*. Corolla 6" to 9" long, spotted within. Aug., Sept.

4. *G. auriculata*, Mx. **AURICLED GERARDIA**. A rough-hairy annual, of low grounds and prairies from Pa. to Minn. south to N.C. and Mo., with erect, rigid, nearly simple stem, 12' to 18' high, opposite, sessile, *ovate-lanceolate to lanceolate leaves 1' to 2' long, lower ones entire, but the others auricled at the base, with 2 oblong-lanceolate lobes*, and solitary, purple flowers 8" to 10" long, sessile in the upper axils. Aug., Sept.

XIII. CASTILLEJA, L. PAINTED CUP. Herbs, mostly American, parasitic on roots of other plants, with alternate, entire or lacinate leaves, and yellow, red, purplish, or white flowers in dense, terminal, leafy-bracted spikes, the bracts often more highly colored and conspicuous than the flowers. Calyx tubular, flattened, 2 to 4-cleft. Corolla tubular, flattened laterally, 2-lipped; upper lip linear, very long, arched, keeled, infolding the didynamous stamens; lower lip short, 3-toothed.

1. *C. coccinea*, SPRENG. **SCARLET PAINTED CUP. INDIAN PAINT BRUSH**. A hairy biennial or annual, with slender, simple stem, 1° to 2° high, in wet meadows from Me. to Minn. south to N.C., Tenn., Kan., and Tex. Leaves sessile; radical ones tufted, mostly entire, oblong or obovate; cauline deeply 3 to 5-cleft into linear, divaricate segments; floral ones or bracts similarly cleft, bright scarlet at the summit and longer than the inconspicuous flowers, with 2-cleft calyx nearly as long as the pale yellow corolla.

Being parasitic on the roots of other plants, it does not respond to cultivation, but on its native heath it has evoked the praises of Thoreau for its gorgeous displays in the meadows of N.H.; of Bryant for "its scarlet tufts," "like flakes of fire," in the prairies of the West; and of Alice Lounsberry for its "setting ablaze many a high slope on Grandfather and Roan Mountains" in N.C. May to July.

XIV. PEDICULARIS, L. LOUSEWORT. Herbs, mostly perennial and of the Old World, with usually pinnately cleft or divided, rarely simple and toothed leaves and flowers in bracted spikes or racemes. Calyx 5-cleft or unequally 2 to 3-cleft, the segments sometimes leaf-like. Corolla strongly 2-lipped; upper lip arched, flattened laterally, emarginate; lower lip spreading, 3-lobed. Stamens 4, didynamous, ascending beneath the upper lip.

1. *P. Canadensis*, L. **COMMON AMERICAN LOUSEWORT. WOOD BETONY**. A common, hairy perennial, of dry woods, copses, and banks from Me. to Minn. south to Fla. and Kan., with simple, tufted stems, 5' to 12' high, alternate, petioled, oblong-lanceolate, pinnatifid leaves 3' to 6' long, with toothed segments and reddish or yellowish flowers in a short, dense, leafy-bracted spike, which lengthens in fruit to 5' to 8' long. Calyx cleft on the lower side, oblique. Corolla 8" to 10" long; upper lip

erect, abruptly incurved, with 2 bristle-like teeth below the apex. Capsule oblique, lanceolate, 7" to 8" long, 2 to 3 times as long as the calyx. March to July.

XV. MELAMPYRUM, L. COW-WHEAT. Low annuals, with erect, slender, branching stems, narrow, opposite, entire or toothed leaves, and small, white, yellow, violet, or variegated flowers, solitary in the upper axils or in dense, terminal spikes. Calyx bell-shaped, 4-cleft. Corolla with cylindric tube gradually enlarged above; upper lip compressed, arched; lower 3-lobed, grooved. Stamens 4, didynamous, ascending beneath the upper lip. Capsule oblique, flattened, opening loculicidally. Seeds 1 to 4, smooth, cylindric-oblong.

1. *M. Americanum*, Mx. (*M. PRATENSE*, Var. *Americanum*, Benth.). **AMERICAN COW-WHEAT.** A common plant in dry woods from Me. to Minn. south to Ga. and Ky., with stem 6' to 12' high, opposite branches, lanceolate or linear-lanceolate, acuminate or acute, short-petioled leaves 1' to 2' long, lower ones entire, upper or floral ovate or lanceolate and 2 to 6-toothed at the base, and pale greenish-yellow flowers solitary in the upper axils. June to Sept.

2. *M. latifolium*, Muhl. **BROAD-LEAVED COW-WHEAT.** A plant found in dry woods and on mountain slopes from Pa. to N.C., Ga., and Tenn., very similar to the preceding, but taller, 8' to 16' high, less branching stem, and leaves mainly ovate to ovate-lanceolate, those near the base of the stem much smaller, spatulate and obtuse, and all entire. June to Sept.

ORDER 63. LENTIBULARIACEÆ — BLADDERWORT FAMILY

Small herbs, mostly tropical, growing in water with submersed leaves dissected into filiform segments, and usually furnished with little bladders, or in wet soils with tufted, radical leaves; and, in both cases, with bilabiate, perfect flowers, solitary or racemed on erect scapes. Calyx inferior, 2 to 5-parted, persistent. Corolla deeply 2-lipped, personate, spurred. Stamens 2, included, anthers 1-celled. Ovary free, 1-celled, with free, central placenta, 1 short style or none, and a 2-cleft stigma. Fruit a capsule. Seeds many, minute. Embryo straight, without albumen.

Key to Genera

Terrestrial. Leaves broad, entire, radical	PINGUICULA	I
Aquatic or in bogs. Leaves often dissected and bearing bladders	UTRICULARIA	II

I. PINGUICULA, L. BUTTERWORT. Small, stemless perennials, found in wet, rocky places, with broad, entire, rosulate,

radical leaves, greasy to the touch, whence *Pinguicula*, from *pinguis*, fat, and solitary flowers on naked scapes. Calyx 5-parted, somewhat 2-lipped. Corolla 2-lipped, upper lip bifid, lower trifold, and spurred at base. Stamens very short. Stigma sessile, 2-lobed. The viscid leaves capture insects.

1. *P. lutea*, WALT. YELLOW BUTTERWORT. A pretty little plant, common in low, wet, open, pine barrens from N.C. to Fla., with a radical rosette of soft, obovate, oblong, acute leaves 12" to 18" long, and a solitary, nodding or ascending, yellow flower on a pubescent, naked scape 6' to 14' high. Corolla funnel-form or bell-shaped, with 5 obovate, cleft, spreading lobes 1' across, and a slender spur about one third its length. March, April.

2. *P. elatior*, Mx. PURPLE BUTTERWORT. A plant growing in swamps or on the borders of ponds from N.C. to Fla., with clammy-pubescent, ovate-spatulate tufted, radical leaves 10" to 12" long, and solitary, purple flowers often changing to white, on scapes 8' to 14' high, villous at base. Corolla 12" to 18" long, with ventricose tube, subequal, notched lobes, 1' across, and a compressed, obtuse spur. March, April.

II. *UTRICULARIA*, L. BLADDERWORT. Herbs, floating loosely in the water or rooting in the mud, with finely dissected leaves bearing little bladders, or with entire leaves, if any, and few or no bladders under the ground. Bladders tipped with a few bristles at the orifice, which is closed by a valve opening inward, thus admitting and confining the minute organisms that enter. Flowers solitary or racemed at the top of slender scapes. Calyx deeply 2-parted, the lobes subequal, usually entire. Corolla strongly 2-lipped; upper lip usually erect and entire, the lower 3-lobed, more or less personate and spurred at the base. Capsule globular.

Floating	Nos. 1, 3
Not floating	Nos. 2, 4

1. *U. inflata*, WALT. SWOLLEN BLADDERWORT. A floating perennial, in ponds from Me. to Fla., and Tex. west to Ohio, with long, branching stem, and finely dissected leaves suspended in the water by numerous, minute bladders, and erect, 3 to 10-flowered scapes 6' to 15' high, *involucrate midway, at the surface of the water, with a whorl of 5 to 9 leaves with inflated, club-shaped petioles 6" to 24" long.* Flowers yellow; upper lip rounded; spur appressed, half as long as the corolla. Style distinct, short. April to Aug.

2. *U. vulgaris*, L. GREATER BLADDERWORT. A floating perennial, common in stagnant pools or sluggish streams throughout most of North America, also in Europe and Asia, with very branching, immersed stem, 1° to 3° long, crowded leaves 6" to 12" long, 2 to 3-pinnately divided into setaceous segments, bearing numerous little bladders, and stout, simple, naked or scaly, 5 to 12-flowered scapes 6' to 12' high. Flowers yellow. Corolla 6" to 9" wide and long; throat closed by the prominent, striped palate; spur conical, shorter than the lower lip. June to Aug.

3. *U. cornuta*, Mx. HORNED BLADDERWORT. A plant common in bogs, shallow waters, or mud on the borders of ponds throughout our area, with a tall, erect, scaly or naked, scape-like stem, 6' to 15' high,

rooting in the mud, with entire, fugacious leaves or none, and bearing 1 to 6 fragrant, yellow flowers 8'' to 10'' wide, on bracted pedicels 1'' to 2'' long. Lower lip helmet-shaped, its convex center (palate) very prominent, and the sides strongly reflexed; upper lip much smaller and obovate. Spur awl-shaped, turned away from and as long as the lower lip. June to Aug.

4. *U. subulata*, L. TINY OR ZIGZAG BLADDERWORT. A little plant, of wet, sandy soils and springy places from Mass. to Fla. and La., near the coast, with few, rarely seen leaves and bladders, and filiform scapes 3' to 5' high, bearing several yellow flowers 2'' to 4'' wide, in a raceme becoming zigzag with age, on hair-like, bracted pedicels 3'' to 6'' long. Spur acute, appressed to and nearly as long as the flat, 3-lobed, lower lip. March to Aug.

ORDER 64. ACANTHACEÆ — ACANTHUS FAMILY

Chiefly tropical plants, mostly herbs, or in the tropics sometimes shrubs, with opposite, simple, exstipulate leaves, and irregular or nearly regular, perfect, usually conspicuously bracted flowers. Calyx persistent, 5-parted, segments imbricated in the bud. Corolla monopetalous, the tube bearing the didynamous or diandrous stamens; the limb nearly regular or 2-lipped, with the lobes convolute or imbricate in the bud. Ovary free. Style filiform. Stigma simple or 2-cleft. Capsule 2-celled, 4 to 12-seeded, opening loculicidally and elastically. Seeds without albumen, usually flat and supported by hooked prejections (retinacula) or by cup-like expansions of the placenta.

Key to Genera

Erect herbs, terrestrial. Stamens 4	RUELLIA I
Erect herbs, growing in water. Stamens 2	DIANTHERA II
Exotic, climbing vines. Stamens 4	THUNBERGIA III

I. *RUELLIA*, L. Chiefly American and tropical, perennial herbs or shrubs, with mostly entire leaves, and usually showy, violet, blue, purple, or white flowers, solitary or clustered in the axils, or in terminal, cymose panicles. Calyx 5-parted, segments narrow. Corolla funnel-form or salver-form, with spreading limb of 5 rounded or ovate, nearly equal lobes. Stamens 4, didynamous. Capsule oblong or club-shaped. Seeds 6 to 20, resting on hooks.

1. *R. strépens*, L. SMOOTH RUELLIA. A smooth or slightly pubescent, green, perennial herb, common in rich soil and dry woods from Pa. to Wis. south to Fla. and Tex., with 4-angled, simple or branched stem, 1' to 3' high, obovate or oblong, acute leaves 2' to 3' long, narrowed to a petiole, and blue flowers 18'' to 24'' long, and nearly as wide, solitary or 2 to 3 together, in the opposite axils. Corolla tube about as long as the

calyx or the campanulate-funnel-form throat and limb. Calyx segments linear-lanceolate, ciliate, 8" to 12" long, not longer than the club-shaped capsule. Cleistogamous flowers common in the narrower-leaved Var. cleistantha, GRAY, which is often found with the type. May to Aug.

2. *R. ciliosa*, PH. HAIRY RUELLIA. A hoary-hirsute herb, found in dry, rich soils from southern N.J. and Pa. to Mich. and Neb. south to Fla. and La., somewhat similar to the preceding, but with the corolla tube twice as long as the calyx or the obconic throat and limb; and the hirsute, filiform calyx segments longer than the capsule. Var. *ambigua*, GRAY, is a hybrid with No. 1. Has also cleistogamous flowers. June to Sept.

II. **DIANTHÈRA**, L. Chiefly perennial herbs, mostly American and of warm regions, with usually entire leaves and very irregular, bracted flowers, solitary or clustered in the axils. Calyx 4 to 5-parted, segments narrow. Corolla tube slender, limb 2-lipped; upper lip erect, concave, entire or 2-toothed; lower 3-lobed, with veiny, rugose palate. Stamens 2; anther cells unequal, divergent, separated by a dilated connective, which makes the anther seem double (*Dianthera*). Capsule with solid, stipe-like base, 2-celled above the middle, 4-seeded.

1. *D. Americana*, L. DENSE-FLOWERED WATER-WILLOW. A very smooth perennial, growing in shallow water or wet places from north-western Vt. to Wis. south to Ga. and Tex., with slender, usually simple, erect, grooved, and angled stem, 1° to 3° high, *willow-like*, linear-lanceolate, obscurely crenate or wavy, nearly or entirely sessile leaves 2' to 6' long, and violet-purple or nearly white flowers in subcapitate, bracted spikes on opposite or alternate, axillary peduncles as long as the leaves. Corolla and capsule, each 6" long, twice the length of the lanceolate, subequal sepals and bracts. May to Aug.

III. **THUNBÉRGIA**, L. Old World, tropical, mostly climbing and perennial herbs, sometimes shrubs, or rarely dwarf and erect plants, with ovate, lanceolate, cordate, or hastate leaves, and purple, blue, yellow, or white flowers, solitary or racemed, axillary or terminal. Calyx very short, truncate or 10 to 15-toothed, inclosed by 2 large, leaf-like bracts. Corolla with curved, trumpet-shaped tube, and spreading, oblique limb of 5 rounded lobes twisted in bud. Stamens 4, didynamous, included. Ovary on a fleshy disk. Capsule globose, ending in a flat beak, 2-celled, 4-seeded, rarely 2-seeded. Seeds in a cup-like expansion of the placentæ.

1. *T. grandiflora*, ROXB. A tall, climbing perennial from India, cultivated in greenhouses or hardy in the Southern States, with ovate to lanceolate, acute leaves 5' to 6' long, cordate at base, toothed, often angularly lobed, pubescent, roughish or smooth, petiolate, and bright blue, sometimes white flowers 2' to 3' long and wide, solitary or in short, stout racemes in the axils, on pedicels 6" to 8' long. Variable. Summer to autumn.

ORDER 65. VERBENACEÆ — VERVAIN FAMILY

Herbs, shrubs, or trees, with exstipulate, mostly opposite or whorled leaves, and more or less 2-lipped or irregular, monapetalous flowers. Calyx inferior, usually persistent, generally with 4 or 5 segments or teeth. Corolla 2-lipped or nearly regular, with lobes imbricated in the bud. Stamens 4, mostly didynamous, rarely equal, sometimes only 2. Style 1, terminal. Stigmas 1 or 2. Fruit dry or drupaceous, 2 to 4-celled, 1-celled in *Phryma*, forming as many 1-seeded nutlets. Seeds without albumen. Embryo straight.

Key to Genera

Corolla salver-shaped. Ovary 4-celled	VERBENA I
Corolla 2-lipped. Ovary 1-celled	PHRYMA II

I. VERBENA, L. VERVAIN. VERBENA. Herbs or sometimes undershrubs, nearly all American, with mostly opposite leaves, and variously colored, bracted, sessile flowers in terminal, loose or dense spikes, solitary, corymbd or paniced. Calyx tubular, 5-toothed. Corolla salver-form; tube often curved, limb unequally 5-cleft. Stamens 4, included; upper pair sometimes without anthers. Style slender. Stigma usually 2-lobed. Fruit splitting into 4 1-seeded, indehiscent carpels or nutlets. The species with small flowers in slender spikes are known as *Vervains*, those with large, showy flowers in capitate spikes as *Verbenas*.

Flowers small. Spikes slender, loose in fruit	Nos. 1, 2
Flowers small. Spikes slender, dense in fruit. Leaves broad	No. 3
Flowers small. Spikes slender, dense in fruit. Leaves narrow	No. 4
Flowers small. Spikes slender, dense in fruit. Leaves hoary	No. 5
Flowers large. Spikes short, corymbous	Nos. 6, 7

1. V. officinalis, L. BRITISH COMMON VERVAIN. A European annual, naturalized by roadsides and in waste grounds from Me. to Fla. and Tex., with erect or ascending, slender, smooth or smoothish stem, 1° to 3° high, branched above and minutely pubescent, opposite, lanceolate to oblong, pinnately lobed or toothed, subsessile leaves 1' to 3' long, and lilac flowers 1'' to 2'' wide, in slender, dense, paniced spikes, afterward elongating and becoming loose in fruit. Bracts not longer than the calyx. Other British names are *Holy Herb*, *Simpler's Joy*, *Juno's Tears*, etc. June to Sept.

2. V. urticæfolia, L. WHITE OR NETTLE-LEAVED VERVAIN. A homely, perennial weed, common in waste places throughout our area, with erect, strict, slender, 4-sided stem, 2° to 4° high, ovate or ovate-lanceolate, serrate, acute, petioled leaves 2' to 5' long, resembling nettle leaves (*urticæfolia*), and numerous, loose, filiform, axillary and terminal, erect or spreading spikes of white flowers 1'' wide. Fruit scattered, not

at all imbricated. Hybrid forms occur with blue flowers and leaves incised or 3-cleft near the base. June to Sept.

3. *V. hastata*, L. BLUE OR COMMON Vervain. A common perennial, by roadsides and in low, moist grounds nearly throughout our area, with strict, erect, 4-sided stem, 3° to 6° high, paniculately branched above, rough, rugose, lanceolate, acute or acuminate, serrate, petiolate leaves 3' to 6' long, lower ones often lobed or hastate, and slender, dense, imbricated, erect, parallel, panicked spikes, usually peduncled, 2' to 6' long, of blue flowers 1'' to 2'' wide. Fruit closely imbricated. Hybrids occur with cleft leaves and loose-flowered spikes. July to Sept.

4. *V. angustifolia*, Mx. NARROW-LEAVED Vervain. A low, hairy perennial, of rocky hills or dry soils from Mass. to Minn. south to Fla. and Ark., with erect, mostly simple stem, 6' to 18' high, sessile, rough, narrowly lanceolate or spatulate, obtuse, serrate or serrulate leaves 2' to 3' long, and solitary, terminal, usually peduncled, slender, dense spikes 2' to 6' long, of purple flowers about 3'' wide and long. June to Aug.

5. *V. stricta*, VENT. HOARY OR MULLEIN-LEAVED Vervain. A very leafy, rather attractive, simple or branched perennial, hoary all over with soft, whitish hairs, common in dry soils, barrens, and prairies from Ohio to Minn. and S. Dak. south to Tenn and Tex., and naturalized as a weed farther east. Stem stout, rigidly erect, 1° to 3° high. Leaves rugous, sessile, obovate or oval, acute or obtuse, unequally serrate or incised, 2' to 3' long. Spikes erect, dense, imbricated. Flowers blue, 4'' to 5'' long and wide, or 3 times as large as in *V. hastata*. Hybrids occur. June to Sept.

6. *V. Aubletia*, L. (*V. CANADENSIS*, BRITTON.) AUBLET'S OR AMERICAN VERBENA. A rather hairy perennial, of dry soils from Ind. to Kan. south to Tenn., Fla., and Tex., and common in cultivation as an ornamental annual, with weak, ascending stem and branches, 8' to 15' high, often from a creeping and rooting base. Leaves 1' to 3' long, distinctly petioled, ovate or ovate-oblong in outline, incisely lobed and toothed, often deeply 3-parted, with truncate or broadly cuneate base. Spikes solitary, terminal, peduncled, short, capitate, or corymbd in early bloom, lengthening 2' to 4' in fruit. Corolla 6'' to 10'' long and wide, lilac to rose-purple or white, or, in cultivation, of various colors. Bracts half as long as the calyx. June to Oct.

7. *V. chamædrifolia*, Juss. SCARLET VERBENA. The first species of the genus cultivated for ornament, about 1827, and the parent of many of the garden, annual varieties, a perennial, from southern Brazil, with slender, hirsute, forking stem, creeping at base, oblong-ovate, acute, crenate-serrate, nearly sessile leaves, and scarlet or crimson flowers in a flattish corymb on a long, ascending peduncle. Bracts less than half the length of the long, cylindric, hairy calyx. Many varieties in cultivation. June to Oct.

II. *PHRYMA*, L. LOPSEED. A perennial herb, with slender, erect stem, divergent branches, opposite, simple leaves, and inconspicuous flowers in loose, slender, terminal spikes. Calyx cylindric, 2-lipped; upper lip longer, 3-cleft; lower 2-toothed. Corolla tubular, 2-lipped; upper lip notched; lower larger, 3-lobed. Stamens 4, didynamous, included. Fruit dry, oblong, striate, 1-celled, 1-seeded.

1. *P. Leptostachya*, LOPSEED. A plant 2° to 3° high, common in moist and open woods from Canada to Fla. and Kan., with thin, ovate, acute or acuminate, coarsely dentate leaves 3' to 5' long, and light, purple flowers 3'' long, mostly opposite, on very short, bibracteolate pedicels, erect at

first, then spreading, and *finally in fruit reflexed and appressed against the axis of the spike*, whence comes the name.

A singular plant, the only one of its genus, and, on account of its 1-celled, 1-seeded ovary, regarded by some as an interloper in this family and accordingly set aside as a family by itself, the *Phrymaceæ*. Found also in Japan and eastern and central Asia. June to Aug.

ORDER 66. LABIATÆ — MINT FAMILY

Mostly *herbs, with square stems, opposite, simple, aromatic leaves*, axillary flowers, chiefly in cymose, whorl-like clusters (verticillasters), sometimes as if in spikes or heads, more or less *2-lipped corolla* (whence the name *Labiatae*), *didynamous or diandrous stamens*, and a deeply *4-lobed ovary becoming in fruit 4, or by abortion fewer, 1-seeded nutlets or akenes*, never prickly, around the base of the single style, *in the bottom of the inferior, persistent*, regular or 2-lipped, 5-toothed, or 5-lobed *calyx*. Limb of corolla sometimes nearly regular, usually decidedly 2-lipped, upper lip 2-lobed or entire, arched or nearly wanting, exterior in bud to the larger, 3-lobed, lower lip. Stamens inserted in the tube of the corolla, the fifth or upper (posterior) one, and in diandrous flowers the adjacent pair also sometimes represented by sterile filaments or rudiments, rarely the 4 stamens equal. The 2 anther cells often separated. Stigma 2-lobed. Seeds mostly with straight embryo and little or no albumen.

A large order, 2700 species, widely distributed. A remarkably natural group, so uniform in features that the discrimination of its genera is often very difficult, depending mainly on the forms of the calyx and corolla, and the number, length, and direction of the stamens. Equally uniform in properties, the foliage of all the species secretes more or less an aromatic oil and a bitter principle, which separately or jointly render the plants tonic, cordial, stomachic, and febrifugal. *No species, it has been declared, is poisonous or even suspicious.*

Key to Genera

- § Stamens 2, perfect, — ascending beneath the upper lip. (Tribe IV.)
 - exserted, distant. (d)
- § Stamens 4, perfect, — all declined toward the lower lip. (Tribe I.)
 - erect or ascending toward the upper lip. (2)
- 2. Stamens equal or nearly so. Corolla almost regular, 4 to 5-lobed. (c)
- 2. Stamens, upper pair longer than the lower (outer). Calyx 18 to 15-veined. (Tribe V.)
- 2. Stamens, lower pair longer than the upper (inner) pair. (3)
- 3. Stamens divergent, apart, mostly straight and exserted. (e)
- 3. Stamens parallel, ascending and long-exserted from the upper side. (b)
- 3. Stamens parallel, ascending in pairs beneath the upper lip. (4)
 - 4. Calyx 18-veined, 5-toothed, and somewhat 2-lipped. (f)
 - 4. Calyx 5 to 10-veined or irregularly netted. (5)

5. Calyx strongly 2-lipped, upper lip truncate, closed in fruit. (n)
 5. Calyx not 2-lipped, 3 or 4-lobed, open in fruit. (k)
 5. Calyx subequally 5-toothed, teeth not spinescent. (m)
 5. Calyx subequally 5-toothed, teeth spinescent. (n)
 5. Calyx unequally 8 to 10-toothed. (o)
- Tribe I**
 Corolla, upper lip 4-lobed, lower entire, flattish *ÖCIMUM* *
 Corolla, upper lip 4-lobed, lower saccate, deflexed *HYPTIS* *
 Corolla, upper lip 2-lobed, lower 8-lobed *LAVANDULA* *
- Tribe II**
 b. Stamens exerted through a fissure in the tube *TEUCRIUM* I
 b. Stamens very long, involute, arching the corolla *TRICHOSTEMA* II
 c. Corolla limb equally 5-lobed. Stamens short *ISANTHUS* III
- Tribe III**
 c. Corolla limb 4-lobed, upper lobe broadest *MENTHA* IV
 d. Corolla nearly regular, 4-lobed. Calyx naked in the throat *LYCOPUS* V
 d. Corolla bilabiate, —cyanic, throat naked. Stamens straight *CUNILA* VI
 —cyanic, throat naked. Stamens ascending *HEDEOMA* VII
 —yellow, throat with a hairy ring inside *COLLINSONIA* VIII
 e. Calyx 15-veined. Stamens exerted, divergent *HYSSÖPUS* *
 e. Cal. 10-veined, the veins obscured by hairs. Cor. yellow, fringed *COLLINSONIA* VIII
 e. Cal. 10 to 18-veined, throat naked. —Stms. straight, diverg. *PYCNANTHEMUM* IX
 —Stamens ascending, anthers spurless *SATURÉIA* *
 —Stamens ascending, anthers spurred *DICERÁNDRA* *
 throat hairy. —Bracts large. Erect herbs *ORÍGANUM* *
 —Bracts minute. Creeping herbs *THYMUS* X
 f. Tube of corolla straight. Leaves small, subcrenate or entire *CALAMINTHA* XI
 f. Tube of corolla curved upward. Leaves large, coarse-crenate *MELISSA* *
- Tribe IV**
 Connective long, transverse, distancing the anther cells *SALVIA* XII
 Connective continuous with filament, toothed at the juncture *ROSMARINUS* *
 Connective inconspicuous. —Calyx subequally 5-toothed *MONARDA* XIII
 —Calyx bilabiate, aristate *BLEPHÍLIA* *
- Tribe V**
 Stamens distant, exerted. Flowers in terminal spikes *LOPHÁNTHUS* *
 Stamens all ascending. —Anther cells divergent, much *NEPETA* XIV
 —Anther cells divergent, little *DRACOCÉPHALUM* *
 —Anther cells parallel. Flowers large *CEDRONÉLLA* *
- Tribe VI.** (Stamens parallel, ascending. Calyx 5 to 10-veined.)
 h. Calyx lips toothed, upper 3 teeth minute, lower 2 large *BRUNELLA* XV
 h. Calyx lips entire, upper with an appendage on the back *SCUTELLARIA* XVI
 k. Cal. 8-lobed. Anths. all distinct. Fls. purple streaked *MACBRIDEA* *
 k. Calyx 4-lobed. Anthers, the highest pair connate *SYNÁNDRA* *
 m. Corolla tube inflated in the midst, whitish. Lips small *PHYSOSTÉGIA* *
 m. Corolla tube inflated at the throat, purple. Lower lip long *LAMIUM* XVII
 m. Corolla inflated in the broad, concave, upper lip, purple or yellow *PHLÓMIS* *
 m. Corolla not inflated, short. —Calyx salver-form, 10-ribbed *BALLÓTA* *
 —Calyx broad bell-form, netted *MOLLUCÉLLA* *
 n. Anthers opening transversely, ciliate-fringed. Lvs. notched *GALEOPSIS* XVIII
 n. Anthers opening lengthwise. —Akenes rounded at the top *STACHYS* XIX
 —Akenes truncate, 3-angled at top *LEONURUS* XX
 o. Corolla white, upper lip flattish. Style equally bifid *MARRUBIUM* XXI
 o. Corolla white, upper lip concave. Style unequally bifid *LEUCAS* *
 o. Corolla scarlet, exerted. Calyx, upper tooth longest *LEONÓTIS* *

* Consult for the genera marked with the asterisk the fuller floras of Gray's or Britton's Manual, Wood's Class Book, Chapman's Flora, or Gray's Field, Forest, and Garden Botany.

I. TEUCRIUM, L. GERMANDER. WOOD SAGE. Herbs or shrubs, widely distributed, mostly of the Old World, with flowers in terminal spikes, racemes, or heads, or verticillate in

the upper axils. Calyx tubular or bell-shaped, 5-toothed. Corolla tube short; limb by a deep cleft in the small, upper lip obliquely 5-lobed, the 4 upper lobes small, nearly equal, the fifth and lowest, the largest and rounded. Stamens 4, didynamous, exserted from the cleft between the 2 upper lobes, the anterior or lower pair the longer. Anther cells divergent, confluent.

1. *T. Canadense*, L. AMERICAN GERMANDER OR WOOD SAGE. A hoary-pubescent perennial, of fields, thickets, roadsides, and low, moist grounds throughout our area, with slender, erect, simple or branched stem, 1° to 3° high, lanceolate, serrate, acute or acuminate, short-petioled leaves 2' to 5' long, rounded at base, green above, hoary beneath, and purple, pink, or cream-colored flowers 6'' to 10'' long, in crowded, bracted whorls forming a simple, terminal spike which lengthens in fruit. Bracts linear-lanceolate, upper ones not longer than the hoary calyx, lower ones sometimes leaf-like. July to Sept.

II. *TRICHOSTEMA*, L. BLUE CURLS. Low annual or perennial, U.S. herbs, a few west of the Rockies shrubby, with entire leaves, and mostly blue or violet flowers in loose panicle cymes. Calyx in our eastern species very oblique, veiny, 2-lipped, lower lip of 2 short teeth, upper of 3, twice or thrice as long, all acute. Corolla tube slender, shorter than the oblique, 5-lobed limb. Stamens 4, anterior pair the longer; *filaments very long, capillary, curved, and very much exserted, spinally coiled in bud*; anther cells divergent, at length more or less confluent at base.

1. *T. dichotomum*, L. BASTARD PENNYROYAL. COMMON BLUE CURLS. A pubescent, slightly clammy, or almost smooth annual, of sandy fields and dry or rocky soils from Mass. to Ky. south to Fla. and Tex., with stiff, slender, obscurely 4-angled, much-branched stem, 6' to 18' high, opposite *dichotomous branches*, thin, oblong-lanceolate, obtuse leaves 1' to 2' long, narrowed to a short petiole, and blue or purple flowers 6'' to 9'' long, solitary or 2 or 3 together at the ends of the branches and inverted by the bending of the pedicel, making the upper lip appear the lower. The leaves have a balsamic odor. The Latin generic name refers to the *hair-like stamens*, which, being *blue* and beautifully *curled* or in the bud coiled, suggest the vernacular one. Aug., Sept.

2. *T. lineare*, NUTT. NARROW-LEAVED BLUE CURLS. A more slender, less forking, and smoother annual than No. 1, of sandy soils near the coast from Canada to Ga. and La., with *linear leaves* 12 to 18'' long. Otherwise nearly the same. July, Aug.

III. *ISANTHUS*, Mx. FALSE PENNYROYAL. A pubescent, slightly clammy, branching annual, with lanceolate, acute, entire or sparingly toothed leaves, and nearly regular flowers in loose, axillary cymes. Calyx somewhat bell-shaped, with 5 nearly equal, lanceolate, acute teeth. Corolla tube as long as

the calyx, limb of 5 ovate or obovate, equal, spreading lobes. Stamens 4, nearly equal, incurved, slightly exserted; anthers 2-celled. Monotypic. Eastern North America.

1. *I. cæruleus*, Mx. A leafy plant, with the aspect of Pennyroyal, of dry soils from Canada to Ga. and Tex., with rounded, slender stem, 6' to 18' high, distinctly 8-nerved leaves 12" to 18" long, and numerous, small, pale blue flowers, 1 to 3 in each axil. Corolla 2" to 3" long. July to Sept.

IV. MÉNTHA, L. MINT. Strong-scented, perennial herbs, mostly spreading by slender, creeping rootstocks, with sessile or petioled leaves, and small, purple, pink, or white flowers in crowded, axillary whorls, or dense, continuous or interrupted, terminal spikes. Corolla nearly regular, tube rather shorter than the calyx; limb nearly equally 4-cleft, the upper and broadest lobe entire or notched. Stamens 4, equal, erect, distant, sometimes imperfect. Anther cells 2, parallel. Widely distributed in north temperate regions. Most of the species in our area are naturalized from Europe.

1. *M. vîridis*, L. (*M. SPICATA*, L.) **SPEARMINT.** A nearly smooth, Old World perennial, naturalized in wet soils of settled districts from Canada to Fla. and Kan., and also cultivated for culinary and beverage purposes, spreading rapidly by creeping roots, with erect, branching, 4-sided stems, 1° to 2° high, subsessile, lanceolate or oblong-lanceolate, unequally serrate, acute leaves 1' to 2' long, and pale purple flowers in *slender, interrupted spikes, the whorls distinct and more or less separated, 2' to 4' long in fruit, the central spike exceeding the lateral ones.* Bracts conspicuous, bristle-like, and with the calyx teeth slightly hairy. July to Sept.

2. *M. piperita*, L. **PEPPERMINT.** A European perennial, escaped from cultivation and naturalized in wet places from Canada to Fla. and Tenn., similar to No. 1, but with its ovate or lanceolate, serrate *leaves petioled and dark green, and its purple flowers in dense, short, thick, obtuse, terminal spikes, interrupted only below if at all, and the lateral spikes finally exceeding the central one. The pungent sensation experienced in tasting the leaves, moreover, is followed by one of coldness.* July to Sept.

3. *M. Canadénsis*, L. **HORSEMINT. AMERICAN WILD MINT.** A hairy or smooth, grayish perennial, of moist soils, low grounds, and muddy places from Canada to Va., Tenn., and Neb., with ascending or erect, simple or branched, usually slender stem, 1° to 2° high, petioled, oblong-lanceolate to lanceolate, serrate, acute or obtuse leaves tapering to the base, and pale purple flowers in globular, axillary whorls. Calyx oblong-bell-shaped, hairy, teeth short. Stamens usually exserted. Resembling Pennyroyal in odor; the smooth forms have a sweeter fragrance like *Monarda*. July to Sept.

V. LÝCOPUS, L. WATER HOARHOUND. Low, mint-like, but bitter and only slightly aromatic perennials, of wet or low grounds, with sharply toothed or lobed leaves, and very small,

mostly white flowers in dense clusters in their axils. Calyx bell-shaped, with 4 or 5 acute or obtuse teeth. Corolla bell-shaped, scarcely exceeding the calyx; limb nearly equally 4-cleft or the upper lobe broadest and notched. Stamens 2, distant; upper pair wanting or rudimentary.

1. *L. Virginicus*, L. BUGIEWEED. A plant, common in wet soils from Canada to Fla., Ala., Mo., and Neb., with usually simple, erect, *obtusely 4-angled stem*, 12' to 18' high, often sending out long, slender runners, ovate-lanceolate, serrate leaves, entire and tapering at both ends, on short petioles, and minute, purplish flowers in axillary whorls. *Calyx teeth usually 4, obtuse, and shorter than the nutlets.* Entire plant often purple. July and Aug.

2. *L. sinuatus*, ELL. CUT-LEAVED WATER HOARHOUND. A very variable plant, of wet soils throughout our area, with erect, *acutely 4-angled stem*, 1° to 3° high, rarely sending out runners, oblong-lanceolate, acuminate, sinuately toothed, incised, or pinnatifid leaves, or some upper ones merely sinuate or serrate, 2' to 4' long, tapering to a short petiole. *Calyx teeth 5, triangular-subulate and spinescent, longer than the nutlets.* Rudiments of upper pair of stamens with thickened tips. July, Aug.

VI. *CUNILA*, L. American, perennial herbs or undershrubs, with dentate or entire leaves, and small, white or purplish flowers, with various inflorescence. Calyx 10 to 13-ribbed, equally 5-toothed, throat very hairy. Upper lip of corolla flat, erect, notched; lower spreading, 3-cleft. Stamens 2, erect, distant. Nutlets smooth. Of about 16 species, 2 are of North America, 2 Mexican, the rest Brazilian.

1. *C. Mariàna*, L. AMERICAN DITTANY. STONE MINT. A very aromatic, perennial herb, of dry hills, rocky soils, and woods and thickets from southern N.Y. to southern Ind. south to Fla., Ga., and Ark., with stiff, slender, erect, 4-angled, branched stem, 8' to 20' high, smooth, except the nodes, smooth, nearly sessile, ovate, serrate leaves 6" to 18" long, punctate with pellucid dots, rounded, truncate, or heart-shaped at base, and numerous purplish-pink flowers 6" long, in peduncled, corymbose cymes, axillary and terminal. Corolla much longer than the striate, punctate calyx. Stamens twice as long as the corolla. Very fragrant, has been used as a substitute for tea and in febrifugal infusions. July to Sept.

VII. *HEDEOMA*, PERS. Low, annual or perennial, fragrant and pungent, American herbs, with small leaves, and small, blue or purple flowers, borne toward the tops of the branches in loose, axillary clusters, which often become terminal, leafy spikes or racemes. Calyx 13-nerved, gibbous at base, hairy in the throat, which contracts in fruit, 2-lipped; lower lip 2-cleft, upper 3-toothed. Corolla 2-lipped; upper lip erect, flat, notched; lower 3-cleft, spreading. Stamens 2, fertile, ascending beneath the upper lip.

1. *H. pulegioides*, PERS. COMMON AMERICAN PENNYROYAL. MOCK PENNYROYAL. A strong-scented, pubescent or hairy annual, common in dry fields and woods and by roadsides from Canada to Fla., with erect, slender, branching stem, 6' to 10' high, oblong-obovate to ovate leaves 6" to 15" long, on very short petioles, sparingly toothed above, entire and tapering below, and 4 to 6-flowered, axillary clusters with bluish or purplish corollas 2" to 3" long, about equaling the calyx. Upper calyx teeth triangular, the 2 lower awl-shaped, spinescent. Two sterile filaments present on the upper (posterior) side. A plant in great repute for various domestic purposes, resembling in taste, odor, and some of its uses the true or original Pennyroyal of England and Europe, which is *Mentha Pulegium*, a congener of peppermint and spearmint, called *Pulegium*, i.e. fleabane, by the ancient Romans.

VIII. COLLINSÔNIA, L. HORSE BALM. CITRONELLA. Coarse, strong-scented, perennial herbs, of eastern North America, with thickened roots or rootstocks, large, ovate, serrate, veiny leaves, mostly on long petioles, and small, yellowish flowers, in a terminal, leafless panicle or raceme. Calyx ovoid, small in flower, enlarging in fruit, 10-nerved, 2-lipped; upper lip 3-toothed; lower 2-cleft. Corolla much longer than the calyx, obliquely bell-shaped, ringent; lower lobe of limb declined, fringed, much larger than the 4 subequal, smaller ones apparently forming the upper lip. Stamens 2 or 4, straight, much exserted, divergent.

1. *C. Canadensis*, L. COMMON HORSE BALM. STONEROOT. RICH-WEED. A coarse, nearly smooth herb, common in rich, moist woods and fields from Me. to Wis. south to Fla. and Kan., with stout, erect, or ascending, branched stem, 2° to 4° high, thin, acuminate leaves 4' to 9' long, the lower on long petioles, upper nearly sessile, and a large, loose, terminal panicle of racemes of lemon-yellow, lemon-scented flowers on opposite, small-bracted pedicels. Corolla 5" to 6" long. Fertile stamens 2, and with the style very long. Fruiting calyx 3" to 4" long, strongly ribbed. July to Sept.

IX. PYCNÁNTHENUM, Mx. MOUNTAIN MINT. BASIL. Pungent, aromatic, perennial, North American herbs, with erect stems, corymbously branched above, floral leaves often whitened, and small, whitish, purplish, or purple-dotted flowers in dense, many-flowered, many-bracted whorls, mostly in terminal, sometimes axillary, cymose clusters. Calyx ovate-oblong or tubular, naked in the throat, 10 to 13-nerved, equally 5-toothed, or the 3 upper teeth somewhat united. Corolla short, 2-lipped; upper lip entire or notched; lower 3-lobed. Stamens 4, distant, included or exserted in different flowers; lower pair slightly longer; anther cells parallel.

1. *P. incanum*, Mx. HOARY MOUNTAIN MINT. WILD BASIL. A pale green plant, common in rocky woods, hillsides, and barrens from

Me. to Ind. south to Fla. and Tex., with rather stout, whitish-downy stem, 2° to 4° high, thin, ovate to lanceolate, acute, subserrate leaves 2' to 3' long, finely downy or smooth above, hoary-woolly beneath, the uppermost usually whitened on both sides, and pale red, purple-dotted flowers in loose, mostly terminal, hoary cymes 1' or more wide. Bracts and subequal, subulate calyx teeth more or less awned. Aug. to Oct.

2. *P. lanceolatum*, PH. VIRGINIA THYME. PRAIRIE HYSSOP. A smoothish, fragrant plant, common in dry woods, thickets, and fields from New Eng. to N. Dak. south to Ga., Ala., and Ark., with rather stout, straight, erect stem, 18' to 30' high, rigid, sessile or very short-petioled, lanceolate or linear-lanceolate, acute, entire leaves 1' to 2' long, rounded or obtuse at base, and purplish, spotted flowers in numerous dense, downy, terminal heads 4'' to 6'' wide, on the corymbed branches. Calyx teeth short, triangular-ovate. July to Sept.

3. *P. linifolium*, PH. NARROW-LEAVED MOUNTAIN MINT. A very smooth plant, of little fragrance, found in dry woods, thickets, fields, and prairies from Mass. to Minn. south to Fla. and Tex., with stiff, slender stem, 1° to 2° high, rigid, entire, linear, sessile leaves 1' to 2' long, and whitish flowers in dense, terminal heads 3'' to 5'' wide, less downy than in No. 2. Calyx teeth pointed. July to Sept.

X. THYMUS, L. THYME. Low, branching, erect, spreading or procumbent, Old World, half-shrubby perennials, with small, mostly entire leaves, and small, purple, or rarely white flowers in dense, terminal, leafy heads or loose spikes. Calyx ovoid, 10 to 13-nerved, hairy in the throat, 2-lipped; upper lip 3-toothed; lower 3-cleft. Corolla moderately 2-lipped; upper lip erect, notched; lower spreading, 3-cleft. Stamens 4, straight, usually exserted, divergent.

1. *T. Serpyllum*, L. WILD OR CREEPING THYME. MOTHER OF THYME. A somewhat pubescent, prostrate, very leafy, evergreen plant, of the Mediterranean region, common in old gardens, and escaped and somewhat naturalized in old fields and by roadsides from Me. to eastern Pa. Stems somewhat shrubby, creeping, wiry, forming broad, flat patches, with leafy, ascending branches, each bearing a small, roundish, terminal head of whorled, purple or lilac flowers on very short pedicels. Leaves ovate-oblong or elliptical, 3'' to 5'' long, flat, entire, narrowed to a very short petiole. Variable. Flowers very attractive to bees. Several varieties in cultivation. Var. *citriodorus*, HORT., or *T. citriodorus*, SCHREB., with smaller and prominently veined leaves and a distinct lemon odor, is the *Lemon Thyme* of the gardens. June to Sept.

2. *T. vulgaris*, L. COMMON OR GARDEN THYME. A hoary-downy plant, 1° to 2° high, of southern Europe, cultivated in gardens for its leaves used in seasoning soups, sauces, stews, etc., with usually erect, stiff, and woody stem and branches, sessile, linear to ovate-lanceolate, acute leaves 3'' to 6'' long, the margins more or less revolute, and small, lilac or purplish flowers in terminal, interrupted spikes. More fragrant than the preceding; like it, much frequented by bees. June, July.

XI. CALAMINTHA. Tourn. Herbs or small shrubs, of north temperate regions, with entire or sparingly toothed leaves, and usually purplish or whitish flowers of various in-

florescence, produced all summer. Calyx oblong or tubular, 13-nerved, throat mostly hairy, 2-lipped; upper lip 3-cleft; lower 2-cleft. Corolla tube straight, usually longer than the calyx; throat inflated; limb 2-lipped; upper lip erect, flat-tish, entire or notched; lower spreading, middle lobe longest. Stamens 4; lower pair longer, usually ascending.

1. **C. Clinopodium**, BENTH. (*CLINOPEDIUM VULGARE*, L.) WILD BASIL. FIELD OR STONE BASIL. A hairy, perennial herb, common in borders of woods and thickets and in low grounds from New Eng. to Md. west to the Rockies, possibly introduced from Europe eastward, but certainly indigenous westward, with slender, simple or branched stem, 1° to 2° high, thin, pale green, ovate, obtuse, suberrate, petioled leaves 1' to 2' long, and pale purple flowers involucrate with bristle-like, awl-shaped bracts in dense, sessile, hairy, axillary and terminal, globular clusters 1' wide. *Bracts hairy, as long as the somewhat gibbous and curved calyx, which is nearly naked in the throat.* Native in Europe and Asia. July to Oct.

2. **C. Nepeta**, LINK. BASIL THYME. LESSER CALAMINT. A soft-hairy, strongly aromatic, Old World, perennial herb, naturalized in dry fields, hills, and waste places from Md. to Ky. south to Ga. and Ark., with rather stout, ascending, much-branched stem, 1° to 2° high, small, broadly ovate, obtuse, crenulate, petioled leaves 4' to 8' long, upper ones much smaller, and whitish flowers in loose, peduncled, axillary cymes. *Bracts minute. Calyx straight, not gibbous, hairy in the throat, half as long as the corolla.* June to Sept.

XII. SÁLVIA, L. SAGE. Herbs, undershrubs, or shrubs, widely distributed in temperate and warm regions, with leaves varying from entire to pinnatisect, and mostly showy flowers, varying in color from scarlet, purple, and violet to blue and white, in usually spiked, racemed or panicle clusters. Calyx 2-lipped; upper lip 3-toothed or entire; lower 2-cleft; throat usually naked. Corolla strongly 2-lipped; upper lip erect, concave or arched, entire or notched; lower spreading or pendent, 3-lobed. *Stamens 2; filaments usually short, with a transverse connective, often long and linear, bearing an anther cell at each end, sometimes, at the upper end beneath the upper lip 1 linear, pollen-bearing cell, and at the other an imperfect one or none.* A very large genus, the largest of the order, embracing over 600 species.

1. **S. lyrata**, L. LYRE-LEAVED SAGE. A low, hairy or pubescent, perennial herb, from a somewhat tuberous root, of dry, mostly sandy woodlands, thickets, and meadows from N.J. to Ill. south to Fla. and Tex., with slender, nearly simple, scape-like stem, 6' to 20' high, lyrate, lyrate-pinnatifid or sometimes nearly entire, petioled, rosulate, radical leaves, one or two pairs of smaller, narrow and sessile, cauline ones, and violet-purple flowers in loose, distant whorls of 6 at the top of the square stem. Corolla 1' long, with narrow tube and the straight, upper lip much smaller than the lower. Calyx one third as long as the corolla. *Anther cells both pollen-bearing, the lower usually smaller.* April, June.

2. *S. officinalis*, L. COMMON SAGE. A well-known, culinary plant from southern Europe, with erect, white-woolly, shrubby stem, 1° or more high, dull green, fragrant, oblong-lanceolate, entire or crenulate, rugous leaves 12" to 18" long, and blue flowers in a few, dense, 10 to 20-flowered whorls forming a spike. Upper lip of corolla vaulted, equaling the lower. Varieties are in cultivation with purple and white flowers and with crisped and variously colored and marked leaves. July.

3. *S. splendens*, SELLOW. SCARLET SAGE. A smooth perennial from Brazil, 2° to 4° high, with erect, branching stems, ovate, acuminate, serrate, petioled leaves, *smooth on both sides*, and flowers 2' long, *calyx and corolla both scarlet*, opposite, or in whorls of 2 to 6, forming terminal, pyramidal racemes. Calyx loose, bell-shaped, with 3 teeth, enlarging after the fall of the corolla. Lower lip of corolla 3-lobed; *lateral lobes narrower and reflexed*; upper lip entire. Many varieties; some with white flowers.

4. *S. fulgens*, CAV. CARDINAL OR MEXICAN RED SAGE. A greenhouse shrub or herb from Mexico, 2° to 4° high, with ovate, acute, crenate-serrate leaves 1' to 3' long, *cordate at base, pubescent above, and white-woolly beneath*, and scarlet or crimson flowers disposed as in No. 3, but with the *calyx green* and the 3 lobes of the lower lip of the corolla *equal in size and in the same plane*. July.

XIII. MONÁRDA, L. Erect, aromatic, North American herbs, mostly perennial, with toothed or entire leaves, and conspicuous, white, yellowish, red, purple, or mottled flowers, in a few, dense heads or whorls involucrate with numerous, often colored bracts. Calyx tubular, 15-nerved, subequally 5-toothed. Corolla long and slender, deeply 2-lipped; lips linear or oblong; upper erect or arched, notched or entire; lower reflexed, 3-lobed, middle lobe narrowest and prominently projecting. Stamens 2, fertile, ascending beneath the upper lip, usually exserted. Anthers apparently versatile, the 2 linear cells divergent at base and connate at apex, forming nearly a single, continuous one transverse to the filaments.

1. *M. didyma*, L. OSWEGO TEA. AMERICAN BEE BALM. A handsome and fragrant, somewhat hairy perennial, common in moist soils, especially along streams, from Me. to Mich. south along the mts. to Ga., with stout, simple, or branched, acutely 4-angled stem, 2° to 3° high, thin, roughish, dark green, ovate or ovate-lanceolate, acuminate, sharply serrate, petioled leaves 3' to 5' long, the floral ones and the large, ovate-lanceolate, involucrate bracts tinged with red, and bright, crimson flowers 2' long, in dense, terminal, *often proliferous heads*. Calyx incurved, smooth without, naked or nearly so within. Perfect stamens and style exserted. An upper pair of filaments short and abortive. July to Sept.

2. *M. punctata*, L. HORSE MINT. A minutely downy perennial, common in sandy ground and dry fields from N.Y. to Minn. south to Fla. and Tex., with obtusely angled, branched stem, 2° to 3° high, narrowly lanceolate, acute, remotely and obscurely serrate leaves 1' to 3' long, tapering to a petiole, upper ones sessile, and *pale yellow, purple-spotted flowers 1' long, in numerous, axillary, and terminal clusters*. Involucrate bracts large, yellowish, and red or purple. Calyx downy outside. Stamens not exserted or but slightly. July to Sept.

3. *M. fistulosa*, L. WILD BERGAMOT. An exceedingly variable, smoothish, or downy perennial, common in dry soils, in hedges or thickets, or on dry banks and hills from Me. to Minn. south to Fla. and La., with acutely 4-angled stem, often hollow (*fistulosa*), 2° to 4° high, ovate-lanceolate or lanceolate, acute or acuminate, serrate, nearly smooth, petioled leaves 2' to 4' long, and greenish-white, yellowish, pink, or purplish flowers 12'' to 18'' long, with *exserted stamens and calyx hairy in the throat*, in solitary and terminal heads, or sometimes in axillary clusters. Involucrate bracts various, whitish, purplish, or purple. July to Sept.

XIV. NÉPETA, L. Annual or perennial, Old World herbs, with erect or more or less trailing stems, toothed or incised leaves, and blue, white, or rarely yellow flowers in whorled clusters, crowded in terminal spikes, or axillary and few-flowered. Calyx tubular, obliquely 5-toothed, 15-nerved. Corolla 2-lipped; tube slender, dilated, naked in the throat; upper lip somewhat concave, notched, or 2-lobed; lower spreading, 3-lobed, middle lobe largest. Stamens 4, ascending beneath the upper lip; upper (inner) pair longer; anther cells divergent.

§ Tall. Whorls in a terminal raceme. No. 1
 § GLECHOMA. Low, diffuse, trailing. Flowers axillary No. 2

1. *N. Catària*, L. CATNIP. CATMINT. A pale green, downy perennial, naturalized as a common weed in waste places near dwellings from Me. to Minn. south to Ga. and Kan., with stout, erect, branched stem, 2° to 3° high, ovate to oblong, crenate-dentate leaves 1' to 2' long, usually cordate at base, green above, and whitish-downy beneath, and whitish or purplish, dark-dotted flowers in spiked, leafy-bracted whorls terminating the stem and branches. July to Sept.

2. *N. Glechòma*, BENTH. (GLECHOMA HEDERACEA, L.) GROUND IVY. GILL OVER THE GROUND. A creeping perennial, naturalized and common in carpet-like masses, in damp and shady places, along walls, fences, or hedges, from Me. to Minn. south to Ga. and Kan., with trailing, leafy stem, 6' to 18' long, ascending branches, long-petioled, round-kidney-shaped, crenate leaves 6'' to 18'' wide, green on both sides, and bluish-purple flowers, 2 or 3 together, in axillary clusters. Corolla 3 times as long as the calyx, variegated in the throat. Anther cells divergent at right angles, each pair forming a cross; sometimes wanting. An infusion of the leaves is a common domestic remedy for colds. An ornamental, cultivated form, *Var. variegata*, has variegated leaves. May to Sept.

XV. BRUNÉLLA, Tourn. (PRUNÉLLA, L.) Low, perennial herbs, with nearly simple stems, petioled leaves, and sessile whorls of 6 violet, purple, or white flowers, crowded in dense, terminal, or sometimes also axillary, bracted spikes or heads. Calyx tubular-bell-shaped, about 10-ribbed, naked in the throat, 2-lipped, closed in fruit; upper lip broad, flat, truncate, with 3

short teeth; lower narrow, with 2 lanceolate teeth. Corolla 2-lipped; upper lip erect, concave, entire; lower 3-lobed, spreading. Stamens 4, ascending beneath the upper lip; filaments forked, bearing the anther on the lower point; anther cells divergent. 4 or 5 species widely distributed.

1. *B. vulgaris*, L. SELF-HEAL. HEAL-ALL. ALL-HEAL. A pubescent or nearly smooth plant, very common in woods, fields, and waste places not only throughout our area, as well as northward and westward, but also in Europe and Asia, with slender, ascending or erect, usually simple stem, 6' to 20' high, a few ovate or oblong, entire or toothed, petioled leaves 1' to 2' long, and blue, purple, flesh-colored, or rarely white flowers, in dense, terminal, oblong-ovoid spikes, lengthening in fruit, with a pair of conspicuous, imbricated, broad, reniform bracts beneath each whorl. Corolla 4" to 6" long, nearly twice as long as the green or purplish calyx. Said to be naturalized from Europe, but evidently indigenous northward. Blooms all summer. May to Oct.

XVI. SCUTELLARIA, L. SKULLCAP. Bitter, inodorous, annual or perennial herbs, undershrubs, or rarely shrubs, widely distributed, of various habit, with simple, entire to pinatifid leaves, and blue, violet, yellow, or white flowers solitary or in pairs, or in terminal or axillary, bracted, usually 1-sided spikes or racemes. Calyx bell-shaped in flower, 2-lipped, lips entire; upper appendaged on the back and closed visor-like after flowering, often deciduous in fruit; lower lip persistent. Corolla tube curved, much exserted, throat dilated; limb 2-lipped, upper lip vaulted, entire or notched; lower spreading or deflexed; lateral lobes small, middle one large, convex. Stamens 4, ascending beneath the upper lip; anthers ciliate, lower pair usually 1-celled by abortion. The species here given are all perennial herbs.

- | | |
|---|----------|
| a. Flowers small, 3" to 5" long, in axillary racemes | No. 1 |
| a. Flowers larger, 6" to 15" long, in terminal racemes. (b) | |
| b. Plants smooth, green | No. 2 |
| b. Plants pubescent, hoary. Leaves narrow, mostly entire | No. 3 |
| b. Plants pubescent or hairy. Leaves broader, toothed | No. 4, 5 |
| a. Flowers large or small, solitary in the opposite axils | No. 6 |

1. *S. lateriflora*, L. MAD DOG SKULLCAP. MADWORT. HOODWORT. A smooth plant, common in wet places, along ditches and streams throughout our area, with slender, erect or ascending, usually much-branched stem, 1° to 2° high, thin, ovate to ovate-lanceolate, acuminate or acute, coarsely serrate leaves 2' to 3' long, rounded or subcordate at base, on petioles 6" to 12" long, and small, blue, rarely white flowers 3" to 4" long, in slender, opposite, axillary, or sometimes also terminal, long-stalked, 1-sided, leafy-bracted racemes. Two of the common names arose from the plant's repute with old herbalists as an antidote to hydrophobia. July to Sept.

2. *S. serrata*, ANDREWS. SHOWY SKULLCAP. A green, nearly smooth plant, in woodlands from southern N.Y. to Ill. south to N.C. and Ky., with erect, slender, simple or branched stem, 1° to 2° high, ovate or elliptic,

crenate-serrate, acute or acuminate leaves 2' to 4' long, and blue flowers 1' long, in single, terminal, few-flowered racemes. Lips of corolla equal in length. June, July.

3. *S. integrifolia*, L. HYSSOP SKULLCAP. A hoary, minutely pubescent, intensely bitter plant, of dry grounds in woods or thickets or on grassy roadsides from New Eng. to Fla. and Tex., with slender, erect, usually simple stem, 9' to 24' high, thin, usually lanceolate to linear-lanceolate, obtuse or subacute, *mostly entire leaves* (integrifolia), on short petioles or sessile, 1' to 2' long, but varying in width and margin, the lower sometimes ovate or broadly oval, and crenate or dentate, and bright blue and white flowers 10'' to 15'' long, in loose, terminal, bracted racemes. Corolla slender below, enlarged above, with subequal lips. Bracts lanceolate, longer than the pedicels. May to Aug.

4. *S. canescens*, Nutt. DOWNY SKULLCAP. A plant common in dry or moist soils in woods and thickets and on river banks from Pa. to Kan. and Ark. south in the mts. to N.C. and Ala., with erect stem, 2° to 4° high, much branched above, lance-ovate, acute, crenate, petioled leaves 3' to 4' long, minutely pubescent on both sides, whitish beneath, and numerous flowers in panicles, bracted racemes. Corolla 8'' to 10'' long, canescent; tube white, lips blue, upper lip arched, longer than the lower. Bracts linear-lanceolate. June to Aug.

5. *S. pilosa*, Mx. HAIRY SKULLCAP. A plant of dry, sandy soils in open woods or thickets from southern N.Y. to Mich. south to Fla. and Tex., with slender, nearly simple stem 1° to 2° high, hairy below, pubescent above, oblong-ovate or oval, obtuse, crenate-dentate, petioled, pubescent, veiny leaves 1' to 3' long, in distant pairs, and blue flowers 6'' to 9'' long, in rather short, terminal, often branched racemes. Bracts elliptical or oblong-spatulate, longer than the hairy pedicels and calyx. Variable. June to Aug.

6. *S. galericulata*, L. HOODED SKULLCAP. MARSH SKULLCAP. A smooth or slightly downy plant, common in wet places, especially in ditches and along streams, from Me. to Neb. south to Pa. and Ohio or along the mts. to N.C., with erect, simple, or branched stem, 1° to 2° high, oblong-lanceolate, acute, remotely crenate-serrate leaves 1' to 2' long, subcordate or rounded at base, short-petioled or sessile, and solitary, blue flowers 9'' to 12'' long, usually all turned one way, on short peduncles in the axils of the upper leaves. The most common species in England. Common also to Europe and Asia. June to Sept.

XVII. LAMIMUM, L. DEAD NETTLE. Annual or perennial, diffuse or decumbent, Old World herbs, with petioled, mostly ovate or orbicular, toothed leaves, and flowers in whorled, axillary or terminal clusters. Calyx tubular-bell-shaped, about 5-nerved, with 5 nearly equal, subulate teeth. Corolla tube usually exserted; limb 2-lipped; upper lip erect, concave, entire, narrowed at base; lower lip with broad, cuneate, notched, spreading middle lobe, and small lateral ones. Stamens 4, ascending beneath the upper lip, lower pair longer; anther of 2 diverging cells, often hairy. Style 2-cleft.

1. *L. amplexicaule*, L. HENBIT. HENBIT DEAD NETTLE. A slightly pubescent, annual or biennial herb, naturalized from Europe and common in waste and cultivated grounds from Me. to Minn. south to Fla. and Ark., with slender, decumbent or ascending stems, 6' to 10' high,

roundish, coarsely or incisely crenate leaves 6" to 18" wide, the lower long-petioled, *the upper and floral ones sessile and amplexicaul*, and purple or red flowers in axillary and terminal clusters. Corolla 6" to 8" long; tube slender, much exerted; upper lip downy; lower spotted with white, its lateral lobes truncate. Calyx pubescent. Anthers hairy. April to Oct.

2. *L. purpureum*, L. RED DEAD NETTLE. A European annual, naturalized in waste and cultivated grounds from R.I. to Pa., similar to No. 1, but with its oblong or roundish, crenate *leaves all petioled*, the reddish-purple corolla shorter, 6" long, and the lateral lobes of its lower lip of 1 or 2 short teeth. April to Oct.

3. *L. album*, L. WHITE DEAD NETTLE. A hairy, European perennial, cultivated and escaped from gardens from New Eng. to Va., with petioled, ovate, acute, crenate, dentate, or incised, rugose-veiny leaves, and *white flowers 1' long*, the corolla tube curved, *with an oblique, hairy ring near its base inside*, and a slender tooth on each lateral lobe of the lower lip. April to Oct.

4. *L. maculatum*, L. SPOTTED OR VARIEGATED DEAD NETTLE. A straggling, European perennial, escaped from gardens to roadsides from Me. to Va., with decumbent or ascending, usually branching stems, 8' to 16' long, broadly ovate, crenate, petioled leaves, *usually blotched with white along the midrib, and purplish flowers 1' long, with the hairy ring inside transverse* and the lateral lobes of the lower lip very small. May to Oct.

XVIII. GALEÓPSIS, L. HEMP NETTLE. European and Asiatic, branching, annual herbs, with purple, red, yellow, or variegated, sessile flowers, whorled in the upper axils or in terminal, interrupted, or dense spikes. Calyx somewhat bell-shaped, with 5 subequal, spiny-pointed teeth. *Corolla tube exceeding the calyx*; upper lip entire, concave, erect; lower with large, obcordate middle lobe, and smaller, ovate lateral ones. Stamens 4, ascending beneath the upper lip; lower pair longer; anther cells 2, *each transversely 2-valved, inner and smaller valve ciliate, the outer smooth*. About 6 species.

1. *G. Tetrahit*, L. COMMON HEMP NETTLE. A coarse, hairy weed, naturalized from Europe and common in waste and cultivated grounds from Me. to Mich. south to N.C., with stout, obtusely 4-angled, retrorsely hispid stem, 1° to 3° high, *swollen beneath the joints*, ovate, coarsely serrate, acute or acuminate, petioled leaves 2' to 5' long, *hairy on both sides*, and purplish flowers variegated with white, in dense, axillary whorls or in a leafy-bracted spike. Calyx teeth bristly, as long as the tube. Corolla 8" to 12" long, twice as long as the calyx. June to Sept.

XIX. STACHYS, L. HEDGE NETTLE. WOUNDWORT. Mostly herbs, widely distributed, with purple, red, yellow, or white, sessile or short-pedicelled flowers in approximate whorls, either axillary or more commonly in a terminal spike; whence the generic name, the Greek for spike. Calyx tube angular, bell-shaped, 5 to 10-ribbed, with usually 5 equal, acute or prickly-tipped teeth. Corolla tube cylindrical, *not longer than the calyx*;

upper lip erect or spreading, concave, entire or notched; lower spreading, 3-lobed, middle lobe largest. Stamens 4, ascending beneath the upper lip, lower pair longer, sometimes deflexed or contorted after discharging pollen. About 150 species.

1. *S. palustris*, L. MARSH HEDGE NETTLE OR WOUNDWORT. A coarse, rough perennial, of wet grounds from Me. to Pa. westward to the Pacific, also in Europe and Asia, with stout, erect, retrorsely hispid stem, 1° to 4° high, firm, sessile or short-petioled, *oblong-lanceolate*, acute or acuminate, *crenate-serrate* leaves 3' to 5' long, *hoary beneath*, and pale red, purple-spotted flowers 7" to 8" long. *Calyx hispid*, its erect, spreading teeth half as long as the tube; the whole shorter than the bracts and half as long as the corolla with its *downy upper lip*. June to Sept.

2. *S. aspera*, Mx. ROUGH HEDGE NETTLE OR WOUNDWORT. A perennial herb, common in wet grounds from Canada to Fla. and La., with slender stem, 2° to 4° high, *smoothish on the sides*, retrorsely hispid on the angles, *sparsely hairy or smoothish*, *ovate-lanceolate*, *sharply serrate*, *green leaves distinctly petioled*, and flowers nearly as in No. 1, but with the *corolla 6" long, entirely smooth*, and the *calyx smooth except on the angles*, and the *teeth triangular-awl-shaped and purplish*. June to Sept.

XX. LEONÜRUS, L. MOTHERWORT. Tall, erect, Old World herbs, with palmately cut-lobed leaves, and dense, axillary whorls of small, white, pink, or purplish flowers forming long, leafy spikes. Calyx top-shaped, 5-ribbed, with 5 nearly equal, rigid, subspinescent teeth. Upper lip of corolla entire, hairy, concave, erect; lower spreading or deflexed, 3-lobed, middle lobe obcordate. Stamens 4, ascending beneath the upper lip, lower pair longer. Nutlets 3-angled, truncate, smooth. Eight or ten species, European and Asiatic.

1. *L. Cardiac*, L. COMMON MOTHERWORT. A tall perennial, originally of Tartary, traveling westward with civilization to Europe, thence to America, and now naturalized in waste places near dwellings from Me. to Minn. and Neb. south to N.C. and Kan., with upright, purplish, downy, square stem, 3° to 5° high, 4 vertical rows of rough, long-petioled, palmately lobed leaves, the lower rounded, the upper and floral wedge-shaped at base and 3-cleft, or the uppermost lanceolate and 3-toothed, and pink or purplish flowers 3" to 5" long, in numerous, axillary whorls shorter than the petioles. Corolla longer than the rigid, bristly-toothed calyx; an oblique, hairy ring within its tube; its upper lip white-woolly outside, the lower variegated. June to Sept.

XXI. MARRUBIUM, L. HOARHOUND. Bitter, aromatic, usually woolly, Old World, perennial herbs, with rugose, toothed or cut leaves, and small, purplish or white flowers in crowded, axillary whorls. Calyx tubular, 5 to 10-nerved, with 5 to 10 subequal teeth, acute or spiny tipped, spreading or recurved at maturity. Upper lip of corolla erect, narrow, flat, entire or notched; lower spreading, 3-cleft, middle

lobe broadest, usually notched; tube included. *Stamens* 4, included in corolla tube, lower pair longer. Style 2-cleft. About 40 species, natives of southern Europe and western Asia.

L. M. vulgare, L. COMMON OR WHITE HOARHOUND. A hoary-woolly herb, escaped from gardens and naturalized in fields and by roadsides from Me. to Minn. south to N.C., Tenn., and Tex., with stout stem, 1° to 2° high, branched from the base or several from one root, oval or roundish-ovate, crenate-dentate, petioled leaves 1' to 2' long, rough-veined and whitish above, woolly beneath, and small whitish flowers in dense, hairy, sessile, axillary whorls. Calyx woolly, with 10 alternately shorter, setaceous, spreading or recurved teeth. Used in popular medicine and as an ingredient in cough candy. July to Sept.

ORDER 67. BORAGINACEÆ — BORAGE FAMILY

Chiefly herbs, sometimes shrubs, or rarely trees in the tropics, with round stems, rough-hairy, exstipulate, mostly entire and alternate leaves, and mostly regular flowers in usually coiled (scorpioid) inflorescence. Calyx mostly 5-divided, -parted, -cleft, or -lobed, and persistent, valvate in bud. Corolla gamopetalous, mostly regular and 5-lobed, lobes mostly imbricated in bud. Stamens alternate with lobes of corolla and inserted in its tube or throat. Ovary superior, of 2 carpels, each 2-ovuled, entire, with terminal, single style, or more commonly in most of our genera deeply 4-lobed, as in *Labiata*, becoming in fruit 4 1-seeded nutlets or akenes in the bottom of the calyx.

A large family, chiefly of north temperate regions, with mucilaginous and soothing, slightly bitter, never poisonous properties.

Key to Genera

a. Ovary entire. Style terminal. Fruit fleshy. Shrubs.	. TOURNEFORTIA	I
a. Ovary entire. Style terminal. Fruit dry, separating.	. HELIOTROPIMUM	II
a. Ovary deeply 4-lobed. (b)		
b. Corolla irregular; limb unequal. Stamens, unequal, exserted	. ECHIUM	III
b. Corolla irregular; tube curved. Stamens included	. LYCOPSIS	*
b. Corolla regular. (c)		
c. Akenes unarmed; throat closed by scales. (d)		
d. Corolla wheel-shaped, blue. Anthers exserted	. BORAGO	IV
d. Corolla tubular. Anthers included	. SYMPHYTUM	*
c. Akenes unarmed; throat not closed by scales. (e)		
e. Corolla tubular, with erect, acute lobes	. ONOSMODIUM	*
e. Corolla lobes rounded, imbricate in bud, white or yellow	. LITHOSPERMUM	V
e. Corolla lobes rounded, imbricate in bud, blue, large	. MERTENSIA	VI
e. Corolla lobes rounded, convolute in bud, blue, small	. MYOSOTIS	VII
e. Akenes armed. Corolla funnel-form	. CYNOGLOSSUM	VIII
e. Akenes armed. Corolla salver-form	. ECHINOSPERMUM	IX

* See fuller flores of Wood, Gray, or Britton.

I. TOURNEFORTIA, L. Chiefly erect or twining shrubs, sometimes trees, rarely nearly herbaceous plants, widely distributed over warm regions, with alternate, entire, rough or downy leaves, and small flowers in coiled, 1-sided, bractless spikes or racemes. Calyx 5-parted. Corolla 5-lobed, with cylindrical tube bearing 5 included stamens. Ovary entire, style terminal. Fruit a drupe with two 2-seeded nutlets.

1. *T. heliotropioides*, HOOK. (*HELIOTRÓPIUM ANCHUSÆFOLIUM*, POIR.) SUMMER HELIOTROPE. An erect, garden undershrub from Buenos Ayres, with shrubby base, herbaceous, hairy branches, elliptic, obtuse, wavy-margined leaves, downy on both sides, and numerous, scentless flowers in 1-sided racemes, on 2 to 3-forked, terminal peduncles. Corolla salver-form; tube yellow, included in the hairy, 5-lobed calyx; limb 5-lobed, pale lilac. Drupe globular. May.

II. HELIOTRÓPIUM, Tourn. HELIOTROPE. TURNSOLE. Herbs, undershrubs, or rarely shrubs, widely distributed in warm regions, with mostly alternate, entire, oval to lanceolate leaves, and small, blue or white flowers in circinate, 1-sided spikes. Calyx deeply 5-parted, persistent. Corolla salver-form or short-funnel-form, throat usually open. Stamens included; anthers nearly sessile. Style terminal, short; stigma conical or capitate. Fruit 2 to 4-lobed, at length separating into two 2-celled, 2-seeded carpels, or into four 1-seeded nutlets or akenes.

1. *H. Peruvianum*, C. COMMON HELIOTROPE. A pubescent, erect, greenhouse shrub, 1° to 2° high, from Peru, with veiny, rugose, lance-ovate, short-petioled leaves 1' to 2' long, and small, very fragrant, vanilla-scented, white or purplish-tinted flowers in terminal spikes, branched by 3's and 4's. *Corolla tube little longer than the calyx.* Compare next species.

2. *H. corymbosum*, Ruiz and Pav. A greenhouse shrub from Peru, similar to No. 1, and with it the parent of most of the florists' heliotropes, but with larger and narrower leaves, and its lilac flowers nearly twice as large and in larger and more open clusters. *Corolla tube twice as long as the calyx with its longer and narrower teeth.*

3. *H. Curassavicum*, L. CURAÇOAN OR SEASIDE HELIOTROPE. A smooth, fleshy, more or less glaucous annual, of sandy shores from Va. to Fla. and Tex., from St. Louis to New Orleans, Ore. to Mexico, and of sandy seashores in warm regions generally around the globe, with diffusely spreading or at length prostrate stems, 6' to 18' long, pale, thickish, nearly veinless, oblanceolate or spatulate to linear-lanceolate, obtuse, entire leaves 1' to 2' long, and sessile, white or bluish flowers 2'' to 3' wide, in dense, bractless, peduncled, 2-forked spikes. May to Sept.

4. *H. indicum*, L. (*HELIOPHYTUM INDICUM*, DC.) INDIAN HELIOTROPE. A coarse, hairy annual, naturalized from India, in waste grounds from N.C. to Ill. south to Fla. and Tex., with erect, furrowed, branching stem, 1° to 2° high, ovate or oval, petioled, rugose, veiny leaves 2' to 5' long, and sessile, blue or purple flowers 2'' to 3'' wide, in dense, bractless, terminal, scorpioid spikes, usually simple, rarely forked, 3' to 8' long in fruit. Corolla pubescent, much exserted, throat closed. Fruit smooth, miter-shaped. May to Nov.

III. ÉCHIUM, **TOURN.** VIPER'S BUGLOSS. Coarse, bristly-hairy, Old World herbs or shrubs, with alternate leaves, and rather large, irregular, blue, violet, red, or white flowers in spiked or paniced racemes recurved at the top. Calyx 5-parted; segments narrow, erect. Corolla bell-shaped or funnel-form; limb of 5 unequal, oblique lobes; throat open, naked. Stamens 5, unequal, most of them exserted. Style filiform; stigma cleft. Akenes 4, ovoid, erect, rough; base flat.

1. *E. vulgare*, L. **BLUE WEED. BLUE THISTLE.** A bristly-hairy, European biennial, naturalized as a weed in fields, meadows, and waste grounds from New Eng. to Neb. south to Va., with erect, round, bristly, tubercled, usually simple stem, 1° to 2° high, lanceolate to linear-lanceolate, entire, dull green leaves 2' to 6' long, lower one petioled, upper sessile or amplexicaul, and numerous, showy, bright blue to violet-purple flowers 8'' to 12'' long, in short, crowded, axillary, recurved, 1-sided spikes forming a long, narrow thyse. June, July.

IV. BORÀGO, **TOURN.** **BORAGE.** Annual or perennial, Old World herbs, with oblong or lanceolate, entire leaves, and paniced, drooping, blue flowers. Calyx 5-parted. Corolla rotate, with 5 acute lobes, and a scale at the base of each closing the throat. Anthers connivent into a cone. Akenes ovoid, muriccate, base excavated. Four known species, native around the Mediterranean.

1. *B. officinalis*, L. **COMMON BORAGE.** A bristly-hairy annual from the Mediterranean region, common in old gardens as a pot herb or a salad, with erect stem, 1° to 2° high, spreading or ascending branches, alternate, ovate or obovate, entire leaves 2' to 5' long, lower ones narrowed to petioles, upper sessile, and sky-blue, varying to purple or white, flowers 8'' to 10'' wide, on spreading or recurved pedicels 1' to 2' long, in terminal clusters. *Filaments included.* Sometimes cultivated as a bee plant and for ornament. June to Sept.

V. LITHOSPÉRMUM, L. **GROMWELL.** Chiefly annual or perennial herbs, with usually thick, reddish roots, alternate, sessile, entire, generally narrow leaves, and white, blue, or violet flowers, solitary and axillary, or in leafy-bracted spikes or racemes. Calyx 5-parted. Corolla funnel-form or salver-form; limb 5-lobed; throat open, with or without appendages opposite the lobes. Anthers included, nearly sessile. Stigma obtuse, 2-cleft. Akenes ovoid, erect, *stony*, whence the generic name (Stony-seed), smooth and shining, or brown and rough, with flat base.

1. *L. arvensis*, L. **WHEAT THIEF. CORN GROMWELL.** A rough, annual or biennial weed, slightly canescent, with appressed pubescence, naturalized from Europe, and common in fields and waste places, from New Eng. to Mich. south to Ga. and Kan., with erect, branching stem, 6' to 12'

high, from a reddish-barked, spindle-shaped root, bright green, linear-lanceolate or linear, obtuse or acutish, veinless leaves 6" to 18" long, and small, whitish, nearly sessile, solitary flowers in the upper axils. Corolla funnel-form, about 8" long, equaling or exceeding the linear-lanceolate lobes of the calyx; throat open, unappendaged. Akenes rugose, pitted, or tubercled. May, June.

2. *L. canescens*, LEHM. HOARY PUCCOON. A more or less hoary, soft-hairy perennial, of prairies, fields, open woods, and dry soils from N.Y. to Va. and Ala. west to Minn. and Kan., with erect, usually simple stem, 6' to 15' high, linear-oblong or oblong, obtuse leaves 8" to 18" long, and bright orange-yellow, sessile flowers 6" long, apparently solitary and axillary, in dense, leafy-bracted spikes. Corolla salver-form; throat appendaged; tube naked at the base inside, 8 times as long as the calyx, which is twice as long as the smooth, white, shining akenes. Root long, deep, dyeing red, the Puccoon of the Indians. Flowers dimorphous. May, June.

3. *L. hirtum*, LEHM. HAIRY PUCCOON. A rough, bristly-hairy perennial, of dry grounds and pine barrens from N.Y. to Minn. south to Fla. and Tex., with erect, leafy stem, 1° to 2° high, linear-lanceolate, obtuse, sessile leaves 2' to 3' long, lowest small and scale-like, floral ones ovate-lanceolate, and crowded, orange-yellow, peduncled flowers 7" to 8" long, in short, terminal, leafy racemes. Corolla as in No. 2, but with the tube hairy at the base inside, and only twice as long as the linear, hirsute lobes of the calyx, which is 3 times as long as the smooth, white, shining akenes. Flowers dimorphous. Root dyeing red. April to June.

VI. *MERTENSIA*, ROTH. SMOOTH LUNGWORT. Smooth or pilose, perennial herbs, of north temperate regions, with alternate, entire, mostly broad leaves, often pellucid-dotted, and showy, blue, purplish, or rarely white flowers on slender pedicels, in short, loose, corymbed or paniced, raceme-like clusters. Calyx short, deeply 5-cleft. Corolla trumpet-shaped or tubular-funnel-form; limb with short, obtuse lobes; throat open, naked, or often with 5 folds or ridges between the stamens at the top of the tube. Style long and filiform. Akenes ovoid, smooth or wrinkled. About a dozen species.

1. *M. Virginica*, DC. VIRGINIA LUNGWORT OR COWSLIP. BLUEBELLS. A very smooth, pale green plant, of alluvial banks and rich soils from N.Y. to Minn. south to S.C. and Ark., and often cultivated for ornament, with erect or ascending stem, 12' to 18' high, oval, oblong, or obovate, obtuse leaves 2' to 5' long, radical and lower ones petioled, upper sessile, and numerous, handsome, nodding flowers, varying often in color even in the same plant, through every shade of rich blue and purple to pink or lilac. Corolla somewhat trumpet-shaped, 10" to 12" long, its nearly cylindrical tube twice as long as the spreading or expanded limb, and 3 times as long as the calyx. May, April.

VII. *MYOSÔTIS*, DILL. FORGET-ME-NOT. SCORPION GRASS. Low, more or less hairy, perennial or annual, diffuse or erect herbs, of wide geographic distribution, with alternate, entire leaves, radical ones petioled, cauline sessile, and small, blue,

pink or white flowers, in terminal, finally elongated, bractless, more or less 1-sided racemes. Corolla salver-form; tube equaling or exceeding the 5-cleft calyx; throat closed with 5 small, blunt, concave scales opposite the rounded lobes, which are convolute in bud. Stamens included, filaments short. Akenes ovoid, erect, smooth, fixed by their base; scar small. About 40 species.

1. *M. palustris*, LAM. TRUE FORGET-ME-NOT. An Old World-perennial, escaped from cultivation and naturalized in brooks and wet places from Me. to southern N.Y. and Pa., with slender rootstocks or stolons, ascending, loosely branched, appressed-pubescent or nearly smooth stems, 9' to 20' long, oblong-lanceolate or oblanceolate, obtuse, sessile leaves, lower ones petioled, 1' to 3' long, and loose racemes of *bright blue flowers* with yellow eye; the *limb* of the corolla *flat*, 3" to 4" wide, and the *tube longer* than the appressed-pubescent calyx with its *triangular-ovate, acute lobes*. Akenes *somewhat angled, or keeled on the inner (ventral) side*. May, June.

2. *M. laxa*, LEHM. (*M. PALUSTRIS*, Var. *laxa*, GRAY.) SMALLER FORGET-ME-NOT. A plant, found in wet and muddy places from Me. to Ohio south to Va. and Tenn., also in Europe and Asia, similar to No. 1, in habit, leaves, pubescence, and inflorescence, but with pedicels longer, racemes more lax (*laxa*), the *limb of the pale blue corolla only about 2" wide and concave, the tube not longer than the calyx with its ovate-lanceolate, acutish lobes, and the akenes equally convex on both sides*. May to Aug.

VIII. CYNAGLOSSUM, TOURN. HOUND'S-TONGUE. Coarse, robust, hairy, usually tall herbs, widely distributed in temperate regions, with alternate, entire, usually large leaves, the lowest long-petioled, and purple, blue, or white flowers in terminal, simple or paniced, usually bractless and scorpioid racemes. Calyx 5-parted. Corolla funnel-form; tube short; throat closed by 5 obtuse scales opposite the rounded lobes. Stamens 5, included. Akenes 4, flat or convex, oblique, attached near the apex to the convex or conical base of the style, forming together a more or less pyramidal fruit, and armed all over with barbed or hooked prickles. About 75 species. Generic name, translated *hound's-tongue*, refers to the leaves of No. 1.

1. *C. officinale*, L. COMMON HOUND'S-TONGUE. A *dull green, silky-pubescent, ill-scented biennial*, of Europe and Asia, naturalized as a common weed in pastures and waste grounds from Canada to N.C. and Kan., with stout, erect, hairy stem, 1° to 2° high, *leafy to the top*, usually branched, radical and lower leaves oblong-lanceolate, 6' to 12' long, on slender petioles, upper ones smaller, lanceolate, and sessile by a rounded or clasping by a heart-shaped base, all softly downy on both sides, and reddish-purple, rarely white flowers, 4" wide, in paniced, usually bractless racemes. Akenes *flat above, slightly margined*, attaching themselves by their hooked prickles to passing animals or people.

2. *C. Virginicum*, L. WILD COMFREY. A roughish, *hirsute perennial*, of woods and thickets from Canada to Fla., La., and Kan., with stout, simple stem, 20' to 30' high, *leafless above*, oblong-oval, acute leaves 5' to 8' long, lowest and radical ones petioled, upper ones clasping by a cordate base, *none above the lower half of the stem*, and blue or pale purple flowers 4'' to 5'' wide, in a few, corymbed, bractless racemes raised on a long, naked peduncle. Akenes prickly as in No. 1, but *convex above, not margined and horizontal*. May, June.

IX. ECHINOSPÉRMUM, LEHM. STICK-SEED. BUR-SEED. Pubescent or hispid herbs, chiefly of north temperate regions, with alternate, entire, often narrow leaves, and small, blue or whitish flowers in terminal, bracted or bractless racemes or spikes. Calyx, corolla, and fruit nearly as in *Cynoglossum*, but the *corolla* is usually *salver-form*, and the *akenes* are *erect*, parallel with the style, attached laterally, and armed with barbed prickles all over the back, or in 1 to 3 marginal rows and otherwise naked. The generic name means *hedgehog seed*.

1. *E. Virginicum*, LEHM. (CYNOGLOSSUM MORISONI, DC.) VIRGINIA STICK-SEED. BEGGAR-TICKS. BEGGAR'S LICE. A pubescent biennial (or annual?), found on the borders of woods and thickets, in rocky grounds and rubbish from Canada to Ga., La., and Kan., with erect, furrowed stem, 2° to 4° high, widely spreading, slender branches, remote, oblong-lanceolate to ovate-oblong, acuminate leaves 4' to 8' long, narrowed to a petioled base, rough above, pubescent beneath, radical ones when present round-ovate, cordate, on long petioles, and small, whitish flowers 1'' wide, on short, slender *pedicels recurved in fruit*, in very slender, forked racemes, leafy-bracted at the base. *Fruit globular*, about 2'' in diameter, each of the 4 akenes densely covered with barbed prickles. June to Sept.

ORDER 68. HYDROPHYLLACEÆ — WATERLEAF FAMILY

Mostly herbs, with insipid, watery juice, usually hairy, with exstipulate, mostly alternate leaves, and perfect, regular flowers, generally in scorpioid cymes, racemes, or spikes. Calyx inferior, persistent, 5-parted, sometimes appendaged at the clefts. Corolla gamopetalous, with 5 stamens inserted in the tube, alternate with the lobes. Ovary entire, superior, 1-celled with 2 parietal placentæ, or 2-celled by meeting of the placentæ, 4 to many-ovuled. Styles 2, partly united or distinct. Fruit a 2-valved capsule. Embryo small, in abundant albumen.

About 18 genera and 150 to 160 species, mostly of western North America, with no important properties.

Key to Genera

- § Ovary and pod 1-celled. Styles partly united. Leaves toothed, lobed, etc. (b)
 § Ovary and pod 2-celled. Styles distinct. Leaves entire. (e)
 b. Corolla lobes convolute in bud. (c)
 b. Corolla lobes imbricate in bud. (d)
 c. Stamens exserted. Flowers in forked cymes. **HYDROPHYLLUM** I
 c. Stamens included. Flowers solitary. **NEMOPHILA** #
 d. Flowers solitary. Calyx enlarged in fruit. **ELLISIA** #
 d. Flowers racemed. **PHACELIA** II
 e. Placentæ many-seeded. **HYDROLEA (NAMA)** #

* See fuller floras of Britton, Gray, and Wood.

I. HYDROPHYLLUM, L. WATERLEAF. Erect, perennial herbs, No. 1 biennial, with large, alternate, petioled, lobed, pinnate or pinnatifid leaves, and white, lilac, blue, purplish, or violet flowers in cymose clusters. Calyx sometimes appendaged between its lobes. Corolla ball-shaped, 5-cleft, convolute in bud, the tube bearing within, opposite each lobe, a longitudinal, linear appendage attached along the middle with its edges infolded, forming a nectariferous groove. Stamens exserted; filaments bearded along the middle. Ovary 1-celled, with 2 large, fleshy placentæ, each 2-ovuled. Styles united nearly to the top. Capsule globose, maturing 1 to 4 spherical seeds, one or more usually proving abortive.

The generic name, Greek for waterleaf, refers to some fancied cavity for water in each leaf. Species 6 or 7, all American.

- § Calyx appendaged between the lobes. Stamens little exserted. No. 1
 § Calyx not appendaged. Stamens much exserted. Nos. 2, 3, 4

1. H. appendiculatum, Mx. APPENDAGED WATERLEAF. A rough-hairy biennial, of moist woods from western N. Y. to Minn. south to N. C., Tenn., and Kan., hairy in nearly all its parts, with slender, weak, simple or branched stems, 12' to 18' high, pinnately 5 to 7-divided, long-petioled, radical and lower leaves subpalmately 5-lobed, shorter-petioled stem ones, the lobes of the latter divergent and dentate, and blue, violet, or purple flowers 6'' to 7'' long, on slender pedicels 4'' to 10'' long, in loose, branched cymes. Calyx with lanceolate-awl-shaped segments and a deflexed appendage at each sinus. Stamens little exceeding the corolla. May, June.

2. H. Virginicum, L. VIRGINIA WATERLEAF. A nearly smooth plant, of moist, rich woods from Me. to Minn. south to S. C. and Kan., with weak, slender, ascending or erect stems, 1° to 2° high, pinnate or pinnatifid, petioled leaves, the segments 5 to 7, ovate or ovate-lanceolate, acute, incised or toothed, 1' to 2' long, and white to sky-blue or violet-purple flowers 4'' long, on short pedicels, in slender, peduncled, simple or forked cymes. Stamens and style conspicuously exserted. Calyx lobes narrow, linear, bristly-ciliate. Sinuses unappendaged. Leaves few; lower and radical ones 6' to 10' long, on long petioles. May to Aug.

3. H. macrophyllum, Nutt. LARGE-LEAVED WATERLEAF. A rough-hairy perennial, of rich woods from Ohio to Va., Tenn., and northern Ala. west to the Mississippi River, with a stout stem, 1° to 2° high, oblong-oval leaves (lower ones 8' to 12' long and long-petioled), deeply pinnatifid or pinnate, the segments 9 to 13, oval or ovate, obtuse, coarsely toothed, 1'

to 3' long, and nearly white flowers 6'' to 7'' long, in terminal, dense, globular, long-peduncled cymes. Stamens much exserted. May, June.

4. *H. Canadense*, L. BROAD-LEAVED WATERLEAF. A nearly smooth perennial, of cool, damp, rich woods from Mass. to N.C. west to the Mississippi River, with slender, usually simple stems, 12' to 18' high, roundish, cordate, palmately 5 to 7-lobed, unequally toothed, petioled leaves 3' to 5' wide, lower and radical ones much larger and on long petioles, sometimes with 2 or 3 small, scattered ones on the petioles, and white or purplish flowers in dense, terminal, forked fascicles, on peduncles usually shorter than the petioles. June, July.

II. PHACELIA, Juss. Annual or rarely perennial herbs, with alternate, pinnately divided, lobed or dissected, simple and toothed, or rarely entire leaves, and blue, violet, or white flowers in more or less scorpioid cymes or racemes. Calyx 5-parted, unappendaged. Corolla bell-shaped or nearly rotate, rarely tubular or funnel-form, caducous; tube with or without inside appendages opposite the 5 lobes, which are imbricated in bud. Stamens exserted or included. Ovary 1-celled; styles united below. Pod 1-celled, or nearly 2-celled by the extension of the placentæ; each placenta 2 to many-seeded.

About 80 species, all natives of the New World, mostly North American; a dozen or more cultivated for ornament.

§ <i>PHACELIA</i> proper. Ovules and seeds 4. Corolla lobes entire; tube with appendages in pairs between the stamens	Nos. 1, 2, 3
§ <i>COELENTHUS</i> . Ovules and seeds 4. Corolla lobes fringed; tube without appendages	Nos. 4, 5
§ <i>WHITLAVIA</i> . Ovules and seeds many. A small scale at the base of each stamen	No. 6
§ <i>EDTOCA</i> . Ovules and seeds many. Appendages none,	No. 7
or consisting of 10, narrow, vertical plates	No. 8

1. *P. bipinnatifida*, Mx. LOOSE-FLOWERED PHACELIA. A biennial, of rich soils or shaded banks and along streams from Ohio to Ill. south to Ala., sometimes cultivated for ornament, with erect, hairy, branching stem, 1° to 2° high, long-petioled, pinnately cleft or divided leaves 2' to 5' long, the 3 to 7 segments or leaflets ovate or oblong, acute, incisely lobed or toothed, and numerous, blue or violet flowers 6'' to 8'' wide, on slender pedicels, in loose, forked, elongated, glandular-pubescent racemes. Corolla broad-bell-shaped, with entire lobes, and in the tube 10 longitudinal, ciliate appendages in pairs midway between the bases of the stamens. Ovules and seeds 4. Stamens and style exserted; filaments bearded in the middle. Var. *bravistylis*, GRAY, with smaller corolla and stamens and style not exserted, is noted in Ala. May to July.

2. *P. congesta*, Hook. A downy-canescent, ornamental, garden annual from Tex., 12' to 15' high, with pinnately 3 to 7-divided leaves, a few small lobes interposed, the main divisions oblong or oval, incisely pinnatifid or irregularly lobed, the lowest lobes stalked, the upper ones confluent, and numerous, bright blue flowers 3'' long, in loose, corymbed racemes or spikes. Stamens exserted. Ovules and seeds 4. June to July.

3. *P. tanacetifolia*, Benth. TANSY-LEAVED PHACELIA. A bristly-hairy, ornamental, garden annual, 1° to 3° high, from Cal., with pinnatisect leaves 2' to 6' long, and bluish-pink flowers in dense, corymbed spikes.

Stamens and style conspicuously exserted. Ovules and seeds 4. June, July.

4. *P. Púrshii*, BUCKLEY. (*P. FIMBRIATA*, PURSH.) PURSH'S PHACELIA. A smoothish or pubescent annual, of moist woods, banks, and river bottoms from Pa. to Minn. south to Ga., Ala., and Mo., and sometimes cultivated, with erect stem, 8' to 12' high, diffuse, slender branches, pinnately parted or cleft leaves, lower ones petioled, upper sessile, the 5 to 15 lobes oblong or lanceolate, *acute*, entire or incised, and 9 to 15 light blue flowers 5'' to 6'' wide, on pedicels longer than the lance-linear sepals, in simple, terminal, 1-sided racemes. Corolla nearly rotate, without appendages, its 5 stamens a little longer than the delicately fringed lobes. May, June.

5. *P. fimbriata*, Mx. FRINGED OR MOUNTAIN PHACELIA. A weak, diffuse, sparingly pubescent annual, of mountain woods from Va. to Ga. and Tenn., and sometimes cultivated for ornament, with slender, ascending, simple or branched stems, 4' to 8' high or long, pinnately divided, parted, or cleft leaves, the lower petiolate, the upper sessile, the lobes oblong or roundish, *obtuse*, and 5 to 12 white flowers 4'' to 5'' wide, on slender pedicels about as long as the linear to spatulate, obtuse sepals, in simple, terminal racemes. May.

6. *P. Whitlavia*, GRAY. (*WHITLAVIA GRANDIFLORA*, HARV.) A hairy and glandular, ornamental annual from southern Cal., with loosely branched stem, 1° to 2° high, ovate or deltoid, incisely toothed, *long-petioled leaves*, and *large*, purple or blue, varying to white, *flowers* in loose, terminal racemes. Corolla with cylindric, ventricose tube 1' long, a nearly equal limb of 5 spreading lobes, a *single, small, scale-like appendage at the base of each filament*, and the stamens and style much exserted. Ovules and seeds many. June to Oct.

7. *P. viscida*, TORR. (*EUTOCA VISCIDA*, BENTH.) CLAMMY PHACELIA. A clammy, ornamental annual from southern Cal., with dark, glandular hairs throughout, erect, branching stem, 1° to 2° high, ovate or obscurely cordate, doubly or incisely and irregularly toothed leaves 1' to 2' long, and deep blue flowers 6'' to 10'' wide, with purple or whitish center, in simple terminal racemes. Pods many-seeded. July.

8. *P. Menziesii*, TORR. (*EUTOCA MENZIESII*, R. BR.) MENZIES'S PHACELIA. A rough-hairy, ornamental annual from Cal., with branched stem, 9' to 12' high, linear or lanceolate, mostly sessile and entire leaves, and bright violet or sometimes white flowers 6'' to 9'' wide, in panicle spikes or spike-like racemes. Corolla spreading bell-shaped, twice as long as the calyx. Pods many-seeded. June.

ORDER 69. POLEMONIACEÆ — POLEMONIUM OR PHLOX FAMILY

Herbs, sometimes slightly shrubby, with alternate or opposite, entire, lobed, or variously divided, exstipulate leaves, and perfect, regular or nearly regular flowers variously arranged. Calyx inferior, persistent; lobes or teeth 5, imbricated in bud. Corolla gamopetalous, salverform, funnel-form, bell-shaped or rotate, with the 5 divisions of the limb convolute in bud, and 5 usually unequal stamens inserted in the tube, alternate with the lobes.

Ovary 3-celled, with axile placentæ; style 1; stigmas 3, linear. Fruit a 3-celled, 3-valved pod, usually loculicidal. Seeds few or many. Embryo straight in the axis of the albumen.

Innocent plants of temperate regions, embracing 8 or 10 genera and more than 150 species, mostly North American, many of them ornamental.

Key to Genera

Corolla salver-form. Filaments unequal. Leaves entire	PHLOX	1
Corolla bell-shaped. Filaments equal. Leaves pinnate	POLEMONIUM	11
Corolla tubular-funnel-shaped. Leaves pinnately divided	GILLIA	8

* See flora of Chapman or Wood.

I. PHLOX, L. PHLOX. Perennial, rarely annual herbs, with opposite, sessile or short-petioled, entire leaves, upper sometimes alternate, and showy, blue, purple, red, or white flowers, in terminal, corymbed, or paniced cymes. Calyx tubular-bell-shaped, lobes acute or acuminate. Corolla salver-shaped; tube long, slender, more or less curved. Stamens short, straight, included, very unequally inserted. Capsule ovoid, 3-seeded, finally expanding and rupturing the tube of the calyx. All the species below are perennial, except No. 3.

- a. Stem erect, smooth. Cymes many-flowered, in an oblong or pyramidal panicle Nos. 1, 2
- a. Stem erect, pubescent or hairy, dichotomously branched, cymes simple or corymbed No. 3
- a. Stems erect or ascending, cymes simple or corymbed. (b)
- a. Stems low, diffuse, creeping or tufted. (c)
- b. Plants smooth. Calyx teeth shorter than the tube Nos. 4, 5
- b. Plants hairy. Calyx teeth longer than the tube Nos. 6, 7
- c. Leaves ovate or lanceolate Nos. 8, 9
- c. Leaves subulate No. 10

1. P. paniculata, L. PERENNIAL GARDEN PHLOX. A very common, garden perennial, native in open woods and on river banks from Pa. to Ill. south to Fla. and La., with smooth, stout stem, 2° to 4° high, thin, oblong-lanceolate to ovate-lanceolate, acuminate leaves 3' to 5' long, tapering, or the upper often abrupt or heart-shaped at base, the lower ones petioled, and numerous, pink-purple, scentless flowers on short pedicels, in a *terminal, oblong-pyramidal panicle*. Corolla tube 12'' to 15'' long, slightly curved; lobes roundish, obovate, entire, shorter than the tube. *Calyx teeth awl-shaped, nearly as long as the tube*. The parent of most of the perennial phloxes of the gardens, some being hybrids with the next. July to Sept.

2. P. maculata, L. SPOTTED PHLOX. WILD SWEET WILLIAM. A perennial, of rich woods and moist grounds along streams from N.J. to Minn. south to Fla., Tenn., and Ark., and escaped from gardens farther north, with rather slender, erect, smoothish, *purple-spotted stem*, 2° to 3° high, lanceolate or ovate-lanceolate, sessile leaves 2' to 4' long, tapering to the end from the rounded or cordate base, thicker and firmer than in No. 1, and pink-purple flowers, varying to white, in a *terminal, narrow, oblong panicle*, leafy below. *Calyx teeth triangular-lanceolate, acute, less than half as long as the tube*. Var. *suaveolens*, Wood, or *candida*, Mx. (*P. SUAVEOLENS*, AIT.), common in gardens and occurring wild with the

type, has white, sweet-scented flowers, and smooth, unspotted stem. June to Aug.

3. *P. Drummondii*, Hook. DRUMMOND'S PHLOX. An erect, forkedly branching, glandular-hairy annual, 8' to 15' high, native of Tex., but common in gardens everywhere in numerous varieties, with oblong- or ovate-lanceolate, acute, mucronate, downy leaves, upper ones often alternate and half-clasping, and red, varying to rose, purple, or white flowers with a darker center, mostly in crowded, cymose clusters. The parent of the numerous *annual* phloxes of the gardens. Some cultivated forms, known as *Star Phloxes*, have the normally entire corolla lobes deeply cut. The specific name commemorates the Englishman who in 1835 introduced this species to cultivation. June to Aug.

4. *P. ovata*, L., 1753. (*P. CAROLINA*, L., 1762.) MOUNTAIN PHLOX. A perennial, of open woods chiefly in or along the mts. from Pa. to N.C. and Ala., smooth throughout, with slender, simple or branched stem, 1' to 2' high, ovate or ovate-lanceolate, acute, sessile leaves 1' to 2' long, with rounded or cordate base, or the lower ones larger, 2' to 4' long, and tapering to the base, and pink or rose-red, short-pedicelled flowers 1' long, in dense, corymbed or simple cymes. *Calyx teeth lanceolate or triangular-lanceolate, acute, less than half as long as the tube.* May to July.

5. *P. glaberrima*, L. SMOOTH PHLOX. A smooth, or nearly smooth, perennial throughout, of open woods and prairies from Va. to Wis. and Minn. south to Fla., Ky., and Mo., with slender, erect, clustered stems, 1' to 3' high, thickish, firm, nearly veinless, glossy green, linear-lanceolate or narrow lanceolate leaves 3' to 4' long, tapering gradually to a long, acuminate point, often with revolute margins, and pale pink flowers 9'' to 12'' long, in loosely corymbed, few-flowered cymes. *Calyx teeth as in No. 4, but sharply acuminate.* May to July.

6. *P. pilosa*, L. DOWNY PHLOX. A soft-downy perennial, often glandular, sometimes smooth, common in dry, sandy woods, copses, and prairies from N.J. to Minn. south to Fla. and Tex., with slender, ascending, nearly simple stems, 1' to 2' high, linear to lance-linear, long-acuminate leaves 1' to 3' long, and pink, purple, or white flowers 7'' to 8'' long and wide, in rather loose cymes. *Calyx teeth awl-shaped, awn-like, slender, much longer than the tube.* May, June.

7. *P. amœna*, Sims. (*P. INVOLUCRATA*, WOOD.) HAIRY PHLOX. A soft-hairy perennial, common in dry soils and pine barrens from Va. to Ky. south to Fla. and Ga., with slender, ascending stems, 6'' to 12'' high, linear-lanceolate or linear-oblong, sessile, suberect leaves 6'' to 12'' long, often ovate, on sterile shoots, and bright purple, crimson, or white flowers in dense, terminal, sessile, *leafy-bracted, as if involucrate*, cymes. *Calyx teeth awl-shaped or linear, longer than the tube.* April, May.

8. *P. reptans*, Mx. CRAWLING PHLOX. A low, more or less hairy perennial, of damp woods, chiefly in the Alleghany region, from Pa. to Ga. and Ky., with creeping runners, decumbent, sterile shoots bearing smoothish, obovate leaves 1' to 3' long, narrowed at the base to a petiole, flowering stems 4' to 8' high, bearing smaller, sessile, ovate or oblong, pubescent, often clammy, remote leaves 4'' to 8'' long, and a close, usually simple cyme of 3 to 8 bluish-purple flowers. *Calyx teeth linear-awl-shaped, as long as the tube.* June.

9. *P. divaricata*, L. WILD BLUE PHLOX. A low, diffuse, viscid-pubescent perennial, of moist woods and copses from Pa. and western N.Y. to Minn. south to Fla. and La., with prostrate or decumbent, sterile shoots, and slender, ascending or decumbent flowering stems, 10' to 18' high, linear-oblong to ovate-lanceolate, acute leaves, and pale lilac or bluish flowers in small, loose, terminal cymes. Corolla lobes obcordate or wedge-obovate, notched or entire, 6'' to 8'' long, about as long as the tube, and *farther apart than in most other species.* April, May.

10. *P. subulata*, L. GROUND OR MOSS PINK. A creeping, tufted, evergreen perennial, of dry, sandy soils from southern N.Y. to Mich. south to Fla. and Ky., with pubescent, depressed stems, covering the ground in dense, turf masses, crowded or fascicled, subulate or linear-subulate, stiff, sharp leaves 4" to 10" long, and light blue, pink, or white flowers, nearly 1' wide, in small clusters of 3 to 6, 2' to 5' above the ground. Lobes of corolla obcordate or entire. Calyx teeth subulate, rigid, very acute. Blooms profusely and varies, especially in cultivation. April, May.

II. POLEMONIUM, L. GREEK VALERIAN. JACOB'S LADDER. Perennial, rarely annual herbs, with alternate, pinnate leaves, and blue, violet, white, or yellowish flowers in terminal corymbs or cymes. Calyx bell-shaped, 5-cleft. Corolla bell-shaped, funnel-shaped, or subrotate; limb 5-lobed; tube short, with stamens equally inserted in the throat, the slender filaments declined and hairy at the base. Pod few to several-seeded.

1. *P. réptans*, L. A smooth perennial, of woods and damp grounds from N.Y. to Minn. south to Ga., Ala., and Mo., with slender, creeping roots or rootstocks, weak, spreading stems, 8' to 15' high, 5 to 15-foliolate leaves, leaflets oval-lanceolate, acute, sessile, 6" to 12" long, and a few, nodding, light blue flowers in terminal corymbs. Corolla 6" to 8" wide. Stamens and style included. April, May.

ORDER 70. CONVULVULACEÆ — MORNING-GLORY FAMILY

Chiefly twining herbs, sometimes leafless and parasitic, in the tropics sometimes shrubs, with alternate, exstipulate leaves or scales, and regular, perfect flowers, solitary or clustered on axillary peduncles. Calyx inferior, persistent, of 5 imbricated sepals or lobes. Corolla gamopetalous, salver-form or funnel-form to subrotate, 5-lobed or 5-plaited, convolute in bud; imbricate in *Cuscuta*. Stamens 5, alternate. Ovary free, 2 to 3-celled, each cell 2-ovuled, falsely 4 to 6-celled, each cell 1-ovuled, or in *Dichondra* of 2 distinct pistils. Fruit a 2 to 6-seeded capsule, or in *Dichondra* two, 2-seeded carpels. Embryo large, coiled, curved, plaited or crumpled; albumen usually scanty; without cotyledons in *Cuscuta*.

Key to Genera

- Tribe I.** Leafy plants, with ovary entire. (b)
 b. Style 1; stigma 1, capitate or of 2 to 8 globose lobes **IPOMŒA** I
 b. Style 1; stigmas 2, linear to ovate **CONVOLVULUS** II
Tribe II. Leafy plants, with 2 carpels and 2 styles **DICHONDRA** *
Tribe III. Leafless plants. Parasitic, twining **CUSCUTA** III

* See flora of Gray, Britton, or Wood.

I. IPOMŒA, L. Twining, trailing, or rarely low and erect, annual or perennial herbs, with entire, lobed, or divided leaves, and usually large, cymose, rarely solitary flowers on axillary peduncles. Calyx of 5 sepals. Corolla salver-form, funnel-form, or campanulate; limb entire or somewhat 5-lobed. Style undivided; stigma capitate, entire or 2 to 3-lobed. Capsule globular, 2 to 4-celled, 4-seeded.

Nearly 400 species have been described, widely distributed, chiefly in warm regions. Many are in ornamental cultivation. *I. Batatas* is the SWEET POTATO, and *I. Purga* is the cathartic, JALAP.

- | | |
|--|-----------|
| a. Corolla salver-form, red. Stamens and style exserted | Nos. 1, 2 |
| a. Corolla funnel-form to bell-shaped. Stamens and style included. (b) | |
| b. Stigma 3-lobed. Ovary 3-celled | Nos. 3, 4 |
| b. Stigma 2-lobed or entire. Ovary 2-celled | No. 5 |

1. I. Quamoclit, L. (QUAMOCLIT VULGARIS, CHOISY.) CYPRESS VINE. INDIAN PINK. A tropical, American annual, common in gardens, and escaped to waste and cultivated grounds from Va. to Kan. south to Fla. and Tex., with smooth, slender, twining stem, climbing 5° to 10°, pinnately parted leaves, the segments linear-thread-shaped and parallel, and 1 to 3 scarlet, crimson, or rose-colored, sometimes white flowers on solitary peduncles usually longer than the leaves. Corolla salver-form, with tube expanded above, 12" to 15" long, and nearly flat limb of 5 ovate, acute or acutish lobes. Stamens and style exserted. Ovary 4-celled; 1 ovule in each cell. Called also *Sweet William of the Barbadoes* and *American Red Bellflower*. July to Sept.

2. I. coccinea, L. (QUAMOCLIT COCCINEA, MOENCH.) SMALL RED MORNING-GLORY. A common garden annual from tropical America, somewhat naturalized along river banks and in waste places from Pa. to Mo. south to Fla. and Tex., with smooth or puberulent, twining or trailing stem several feet long, ovate, cordate, acuminate leaves, entire or angled at the base, on slender petioles, and 3 to 5 light scarlet flowers with yellow throat, on solitary peduncles about as long as leaves. Corolla salver-form, with slightly funnel-form, but narrow tube 1' or more long, and an obscurely 5-lobed limb. Stamens and style slightly exserted. Ovary as in No. 1. June to Sept.

3. I. purpurea, LAM. (PHARBITIS PURPUREA, WOOD.) COMMON MORNING-GLORY. A tropical American annual, common in cultivation and somewhat naturalized in waste places from Me. to Neb. south to Fla. and Tex., with twining and climbing, or trailing stem, 4° to 10° long, branching from the base, and retrorsely hairy, broadly ovate, cordate, acute or acuminate, entire leaves 2' to 4' wide, on slender petioles, and purple, blue, pink, striped, or diversely variegated flowers on slender, 2 to 5-flowered peduncles. Corolla funnel-form, 24" to 30" long. Stamens and style included. Capsule 3-celled. Stigma 3-lobed. Many varieties. July to Oct.

4. I. hederacea, JACQ. (PHARBITIS NIL, CHOISY.) IVY-LEAVED MORNING-GLORY. A common, cultivated annual from tropical America, naturalized in fields and waste places from Pa. to Neb., Fla., and La., with slender, retrorsely hairy, twining stem, climbing 2° to 8°, long-petioled, deeply 3-lobed leaves, cordate at base, 2' to 5' long and wide, the lobes nearly ovate, usually entire, and 1 to 3 flowers on solitary peduncles shorter than the petioles. Corolla funnel-form, 12" to 18" long, with white tube, and light blue, purple, or pink limb. Sepals hairy, lanceolate, with long tips. July to Oct.

5. *I. pandurata*, MEYER. WILD POTATO VINE. MAN-OF-THE-EARTH. A perennial, common in dry ground and sandy fields from Conn. to Mich. and Kan. south to Fla. and Tex., with smooth or smoothish, trailing or sometimes twining and feebly climbing stems, 4° to 8° long, from a huge, long, fleshy root, often weighing 10 to 20 pounds, broadly ovate, cordate, acuminate, petioled leaves 2' to 4' long, later ones often angulate, hastately 3-lobed, or contracted near the middle to fiddle-shaped (panduriform or pandurate, whence the specific name), and 1 to 5 large flowers on peduncles longer than the petioles. Corolla open funnel-form, 2' to 3' long, white, with pink or purplish throat. Ovary 2-celled. Capsule 2 to 4-seeded. Indian name *Mecha-Meck*. June to Sept.

II. CONVULVUS, L. BINDWEED. Annual or perennial herbs or undershrubs, with twining, trailing, or erect stems, entire, toothed, or lobed, often sagittate or cordate leaves, and showy, solitary or clustered, axillary flowers, opening usually only in the morning. Calyx 5-sepaled, sometimes with 2 large, leafy bracts at the base. Corolla bell-shaped to funnel-form. Stamens included. Style 1; stigmas 2. Capsule globular, 2-celled, 4-seeded, or by a false partition somewhat 4-celled, or by abortion 1-celled.

More than 150 species widely distributed in temperate and warm regions.

§ CONVULVUS proper. Calyx bractless No. 1
 § CALYSTËGIA. Calyx covered by 2 large bracts Nos. 2, 3, 4

1. *C. arvensis*. SMALL OR FIELD BINDWEED. A low, spreading, Old World perennial, naturalized as a weed in old fields and waste places from Me. to N.C. and westward, with slender, angular, prostrate, decumbent, or twining stems, 1° to 2° long, ovate-oblong, entire, sagittate or hastate, petioled leaves 1' to 2' long, and small, white or pinkish flowers, usually solitary, on bracted peduncles. Corolla broad funnel-form, 9'' and 12'' long and wide. Bracts on peduncle small, acute, above the middle, or at the top subtending the pedicels of 2 or more flowers. June, July.

2. *C. sepium*, L. (CALYSTËGIA SEPIUM, BR.) HEDGE BINDWEED. RUTLAND BEAUTY. A smooth, vigorous perennial, of hedges and thickets or in alluvial soils and along streams from Me. to Minn. and Neb. south to N.C., also in Europe and Asia, with twining or extensively trailing stem, 3° to 10° long, slender-petioled, triangular-hastate, acute or acuminate leaves 2' to 4' long, the basal lobes usually obliquely truncate, and numerous, 1-flowered, quadrangular peduncles longer than the leaves. Corolla about 2' long, white, tinged with pink. The 2 large, leaf-like, ovate, usually acute bracts envelop and conceal the calyx. Var. *Americana*, Sims, with pink or rose-purple corolla and obtuse bracts, is common across the continent. June to Aug.

3. *C. repens*, L. TRAILING BINDWEED. A more or less pubescent or woolly perennial, common in dry fields from Va. to Fla. west to Dak. and Tex., similar to, and made Var. *repens* of No. 2 by GRAY, but with twining or trailing stems, 1° to 3° long, and the ovate or oblong, acute, petioled leaves 1' to 2' long, cordate or sagittate at base, with the lobes rounded or scarcely divergent. Flowers white to pink. Otherwise nearly as in No. 2. June to Aug.

4. *C. spithameus*, L. UPRIGHT OR SPAN-HIGH BINDWEED. A low, downy or smoothish perennial, of dry, sandy fields and hilly pastures

from Me. to Minn. south to Fla. and Ill., with erect or ascending, usually simple stem, 6' to 12' high (whence *spithameus*, of a span), oblong-lanceolate or oval leaves 2' to 3' long, upper ones sessile, lower short-petioled, and 2 or more white flowers 2' long, each on a peduncle 2' to 4' long, from near the base. Bracts large, oval, acutish, concealing the calyx as in Nos. 2 and 3. May to Aug.

III. CUSCŪTA, TOURN. DODDER. STRANGLEWEED. Leafless, parasitic, annual herbs, with yellowish or reddish, thread-like stems, a few minute, alternate scales instead of leaves, and clusters of small, whitish flowers. They germinate in the soil, but soon attach themselves to other plants, around which they twine and from which, by minute suckers, their own roots withering away, they draw their entire nourishment. Calyx 5- (rarely 4-) cleft or sepaled. Corolla globular-bell-shaped, urn-shaped, or somewhat tubular, with the 5- (rarely 4-) cleft, spreading limb imbricate in bud, and, in the tube alternate with the lobes, as many scale-like, usually fringed appendages, and above these the short, usually included stamens. Ovary 2-celled, 4-ovuled. Styles 2, distinct or rarely united. Capsule usually 4-seeded. Embryo thread-like, curved or coiled spirally, without cotyledons, in fleshy albumen.

About 100 species widely distributed in temperate regions. Several are great pests to certain crops, notably the flax dodder, *C. Epithimum*, and the clover dodder, *C. Trifolii* or *Epithymum*, both of which have become naturalized from Europe in flax and clover fields of the Northern States.

1. C. Gronovii, WILLD. GRONOVII'S DODDER. LOVE VINE. A plant, common in moist soils throughout our area, our most common species of the genus, with light orange, filiform stems, often climbing high on coarse herbs or low shrubs, but most conspicuous in tangled masses like yellow yarn on top of the grass in meadows along streams. The flowers, 1½" to 1¾" long, in paniced cymes, at first loose but finally dense, have the whitish corolla tube deeply bell-shaped and longer than the obtuse, spreading but not reflexed lobes. Scales large, as long as the tube, deeply fringed. Ovary and capsule ovoid, slightly conic. *Sepals united below. Styles shorter than the ovary.* Variable. *Var. latiflora*, ENGLER, a common form northward, has the corolla tube shorter and shallower, with longer lobes. July to Sept.

2. C. glomerata, CHOISY. (C. PARADÓXA, RAF.) GLOMERATE DODDER. A plant growing on tall herbs, chiefly *Compositæ*, in wet meadows and prairies from Ohio to Minn. south to Tenn., Kan., and Tex., with slender, yellowish-white stems, and sessile, white flowers with golden-yellow anthers, in dense masses which completely conceal portions of the stem of the host plant and apparently belong to it, while their own stems are decaying and falling away. Flowers white, scarious, 2" long. Corolla tubular-campanulate; lobes obtuse, spreading or reflexed. Scales large, deeply fringed. *Sepals 5, distinct, serrulate, subtended by 8 to 15 narrower, imbricated bracts with recurved tips.* Styles 2 to 4 times as long as the ovary. Anthers partly exerted. July to Sept.

ORDER 71. SOLANACEÆ — NIGHTSHADE OR POTATO FAMILY

Chiefly herbs, rarely shrubs, or in the tropics a few trees, with colorless juice, alternate, exstipulate leaves, often in pairs, and regular or nearly regular, 5-merous, 5-androus flowers on bractless pedicels. Calyx inferior, usually persistent, gamosepalous. Corolla gamopetalous, tubular, funnel-form, salver-form, bell-shaped, or rotate; lobes valvate or imbricate, mostly plaited in bud. Stamens alternate with the lobes of the corolla and inserted in its tube, equal and perfect in the genera here given except in *Petunia*. Fruit a 2-celled, rarely 3 to 5-celled, many-seeded berry or capsule. Embryo curved in fleshy albumen.

A large order embracing more than 60 genera and about 1500 species (Warming), mostly of warm regions, only a few native in our area. The rank-scented foliage and fruits are mostly pervaded by a narcotic principle often rendering them highly poisonous, as in *Belladonna* and *Stramonium*. The *potato*, *tomato*, *eggplant*, *Cayenne pepper*, and *tobacco* are its most notable products.

Key to Genera

- a. Corolla wheel-shaped, tube very short, anthers convergent. (b)
- a. Corolla bell-shaped, tube broad, including the erect anthers. (e)
- a. Corolla funnel-form, tube long, limb somewhat unequal. (d)
- a. Corolla funnel-form, tube long, limb regular. (e)
 - b. Anthers connate, opening by slits inside **LYCOPERSICUM** I
 - b. Anthers connivent, opening by terminal pores **SOLANUM** II
 - b. Anthers connivent, opening by slits. Berry dryish, angular
 - c. Calyx 5-cleft, campanulate, inclosing the fleshy berry **CAPSICUM** *
 - c. Calyx 5-cleft, campanulate, inclosing the fleshy berry **PHYSALIS** III
 - c. Calyx 5-parted, inclosing the dry berry **NICANDRA** IV
 - c. Calyx 5-parted, spreading beneath the fleshy berry **ÁTROPA** *
- d. Stamens exserted. Fruit a capsule, opening by a lid **HYOSCYAMUS** *
- d. Stamens included, unequal. Capsule opening by valves **PETUNIA** V
 - e. Fruit a small, 2-celled berry **LYCIUM** VI
 - e. Fruit prickly (or smooth). Capsule naked, 4-celled **DATURA** VII
 - e. Fruit a capsule surrounded by persistent calyx **NICOTIÀNA** *

* See flora of Wood, Britton, or Gray.

1. LYCOPERSICUM, TOURN. Annual or perennial herbs, with weak stems, trailing or ascending when supported, 1 to 2-pinnately divided leaves, and small, yellowish flowers in irregular, raceme-like cymes. Anthers connate into a pointed cone, the cells opening by slits down the inner face. Otherwise as in *Solanum*. Only a few species, natives chiefly of western South America.

1. L. esculéntum, MILL. TOMATO. LOVE APPLE. A hairy annual of the gardens, with weak stem, irregularly or interruptedly pinnate

leaves, the larger segments cut or pinnatifid, and yellowish flowers in short, forked clusters, the parts of the flower 5, 6, or more. Fruit a smooth, fleshy, torulous, furrowed berry, 2 or 3 to many-celled.

II. SOLANUM, L. Herbs, shrubs, or small trees, of various habit, with the leaves, though strictly alternate, often accompanied, as in many other genera of the order, by a smaller, lateral, or extra-axillary one, and the peduncles also extra-axillary or lateral. Flowers white, yellow, violet, or purple, in cymes, umbels, panicles, or racemes, or rarely solitary. Calyx usually 5-parted or 5-cleft. Corolla rotate, with very short tube and 5-cleft, 5-lobed, or 5-angled limb, plicate and valvate or induplicate in bud. Stamens exserted; filaments very short; anthers connivent, opening at the top by 2 pores or chinks. Berry usually 2-celled, many-seeded.

An immense genus, embracing more than 900 species, widely distributed chiefly in tropical regions, especially in South America. It includes the Eggplant, *S. Melongena*, and the Potato.

Plant unarmed, erect. Berries green or yellow	No. 1
Plant unarmed, erect. Berries black	No. 2
Plant unarmed. Climbing or straggling. Berries red	No. 3
Plants prickly. Calyx persistent beneath the smooth, yellow berry	No. 4
Plants prickly. Calyx prickly, completely investing the berry	No. 5

1. *S. tuberosum*, L. **POTATO.** A low, weak-stemmed, branching perennial, of Chile, Peru, and as far north as southern Colorado, cultivated as an annual, with subterranean branches bearing edible tubers, unequally pinnate leaves, consisting of 5 to 9 oblong-ovate leaflets with much smaller ones interposed, and lilac to white flowers on jointed pedicels, in peduncled, forking clusters. Corolla angularly 5-lobed. Fruit a globular, green or yellow berry. Cultivated in endless varieties.

2. *S. nigrum*, L. **BLACK NIGHTSHADE.** A smoothish, cosmopolitan annual, of weed-like aspect, common in old fields and waste places throughout our area, with erect, angular, branching stem, 1° to 2° high, simple, entire, undulate or toothed, ovate to cuneate-ovate, acute, petioled leaves 1' to 3' long, and white flowers 4'' to 5'' wide, with yellow anthers, in drooping umbels on lateral peduncles 6'' to 18'' long. Berries black, smooth, globose, 4'' to 5'' in diameter, subtended by the persistent calyx; reputed poisonous, but used medicinally. July to Oct.

3. *S. Dulcamara*, L. **BITTERSWEET. WOODY NIGHTSHADE.** A pubescent or smoothish perennial, naturalized from Europe in waste places and moist thickets from Me. to Minn. south to N.J., Pa., and Kan., with a flexuous, climbing or straggling, branching stem, woody below, 4° to 6° long, petioled, ovate or ovate-cordate, entire leaves 2' to 4' long, upper ones becoming hastate or auriculate, some also sometimes deeply 3-lobed or 3-divided, and purple, blue, or sometimes white flowers 5'' to 7'' wide, spreading or drooping, on lateral, branching peduncles. Corolla 5-parted, with reflexed, lanceolate lobes. Berry oval, bright red, reputed poisonous. June to Sept.

4. *S. Carolinense*, L. **HORSE NETTLE.** A rough-downy, perennial weed, of dry fields and waste grounds from Conn. to Neb. south to Fla. and Tex., with erect, branching stem, 1° to 2° high, armed, as also the petioles and veins of the leaves, with numerous, stout, yellowish prickles, oblong or ovate, sinuate-lobed, angularly lobed or pinnatifid, acute, peti-

oiled leaves 4' to 6' long, and pale blue or white flowers 9" to 12" wide, in simple, slender, at first terminal but finally lateral racemes. Calyx lobes acuminate, half as long as the corolla, persistent beneath the smooth, globous, yellow berry 6" to 10" in diameter. June to Sept.

5. *S. rostratum*, DUNAL. SAND BUR. BEAKED NIGHTSHADE. A very prickly, stellate-pubescent, yellowish, or hoary annual, of prairies west of the Mississippi, but now spreading eastward to Ill., Tenn., and Ga., with erect, branching stem, 1° to 2° high, ovate or oval, irregularly and pinnately lobed, or 1 to 2-pinnatifid, petioled leaves 2' to 5' long, and yellow flowers 1' wide, on stout, erect pedicels 3" to 6" long, in lateral racemes. Corolla nearly regular; lobes 5, broadly ovate, acute. Lowest stamen longer than the others and incurved or *beaked* (rostratum). *Calyx densely armed with straight, sharp prickles* as long as the wholly inclosed berry. Fruit inclusive of prickles 1' or more in diameter. May to Sept.

III. *PHYSALIS*, L. GROUND CHERRY. Annual or perennial herbs, chiefly American, with entire, toothed, or lobed leaves, and white, yellow, or violet-purple flowers on slender peduncles, in our species solitary and axillary. *Calyx bell-shaped, 5-cleft; in fruit much enlarged, membranous and inflated like a bladder* (whence the generic name), 5-angled, 10-ribbed, wholly enveloping the globular, 2-celled, pulpy berry. Corolla rotate or rotate-campanulate, plicate in bud, with very short tube and 5-angled or obscurely 5-lobed limb. Stamens 5, erect.

1. *P. pubescens*, L. HUSK OR STRAWBERRY TOMATO. DOWNY GROUND CHERRY. A strong-scented, downy or woolly, viscid, or sometimes nearly smooth annual, of low grounds, sandy soils, and damp, shady places from N.Y. to Minn. south to Fla. and Tex., and often cultivated for its fruit, with diffusely branching, trailing, or at length ascending stem, 9' to 12' or 20' high, cordate or ovate, angularly or repandly toothed, or nearly entire leaves, unequal at base, 2' to 4' long, on long petioles, in pairs on the flowering branches, and yellow flowers 4" to 7" wide, with dark center, and blue, violet, or purplish anthers. Berry greenish-yellow, very sweet, loosely enveloped by the ovate-pyramidal, 5-angled, and keeled calyx. Aug., Sept.

2. *P. Alkekengi*, L. ALKEKENG. EUROPEAN STRAWBERRY TOMATO. WINTER CHERRY. A perennial, of southeastern Europe and Asia as far as Japan, cultivated for its ornamental fruit and somewhat escaped in the Eastern States, with pubescent, angled, zigzag, mostly simple stem, 12' to 18' high, triangular-ovate, acuminate, repand leaves, attenuated to a long petiole, making them 3' to 4' long, and white flowers with yellow anthers. Berry globular, red, edible, sweet, inclosed in the large, bright red, ovoid-globous calyx. July.

IV. *NICÁNDRA*, ADANS. A smooth, Peruvian annual, with erect, branching stem, 2° to 4° high, thin, alternate, ovate-oblong, sinuate-dentate, or lobed, petioled leaves 4' to 7' long, and showy, blue or purple, peduncled, nodding, solitary, axillary flowers 12" to 18" long. Calyx 5-parted, 5-angled, segments sagittate, enlarging in fruit and inclosing the 3 to 5

celled, dry, globular berry. Corolla bell-shaped, with border nearly entire. Otherwise nearly the same as *Physalis*. Genus monotypic.

1. *N. physaloides*, ADANS. APPLE OF PERU. A plant resembling a *physalis* in aspect and fruit (whence its specific name), and a *stramonium* in its leaves, common in old gardens and escaped to waste places and fields from Me. to Fla. Fruit about 6" in diameter, loosely inclosed by the 5-winged calyx. July to Sept.

V. *PETÙNIA*, JUSS. PETUNIA. Annual or perennial, usually clammy-pubescent, branched herbs, cultivated as ornamental annuals, with entire leaves, and usually large, axillary or terminal, solitary, violet-purple or white flowers. Calyx 5-parted, segments oblong-spatulate. Corolla funnel-form or salver-form; limb spreading, obscurely 5-lobed. Stamens 5, inserted near the middle of the tube, *unequal*, included. Anthers cordate. Stigma capitate. Capsule 2-celled, 2-valved. Seeds minute.

About a dozen species, natives of South America. The two below and their hybrids are the parents of the many cultivated varieties.

1. *P. nyctagyniflora*, JUSS. A clammy-pubescent perennial, of southern Brazil and Argentina, common in old gardens and somewhat escaped in N.Y. and Pa., with rather stout and erect, branching stem, 1° or more high, ovate-oblong, obtuse leaves 3' to 4' long, sessile, or lower ones narrowed to a petiole, upper ones smaller and subopposite, and *white flowers* 12" to 18" long, on slender, solitary *peduncles usually longer than the leaves*. *Corolla tube cylindric, slightly enlarged above, 3 times as long as the calyx; limb wide-spreading, nearly 2' across; lobes rounded*. Strong-scented in the evening. July to Sept.

2. *P. violacea*, LINDL. A species similar to the preceding, from the same region and similarly escaped from old gardens, but with lower, weaker, and more slender stem, prostrate at the base, then ascending or erect, ovate, acute, short-petioled leaves, the upper ovate-lanceolate, and *violet-purple flowers* 9" to 15" long, on solitary *peduncles equaling the leaves*. *Corolla tube bell-shaped, the limb spreading less abruptly than in No. 1, 12" to 18" wide, the lobes somewhat acute*. Rarely found now in a pure form. June to Sept.

VI. *LÝCIUM*, L. Trailing, climbing, or spreading shrubs, often spiny, with alternate, usually entire, short-petioled leaves, often with also smaller, fascicled ones, and whitish, greenish, violet, or purple, solitary or clustered, axillary or terminal flowers. Calyx 3 to 5-cleft or -toothed, persistent. Corolla funnel-form, salver-form, or bell-shaped; tube short; limb usually 5-lobed, spreading. Stamens 5 or 4; anthers opening lengthwise. Ovary 2-celled; style slender; stigma capitate. Fruit a small berry.

About 70 species, widely distributed in warm and temperate regions.

1. *L. vulgäre*, DUNAL. (*L. BARBARUM*, Var. *vulgäre*, AIT.) **MATE-MONT VINE. BOXTHORN.** A smooth, spiny, or unarmed shrub from southern Europe, common in cultivation and somewhat escaped and naturalized, with slender, trailing, or climbing stems, long, slender, trailing or drooping branches, grayish-green, narrow, oblong-lanceolate or oblong-spatulate, acute or obtuse leaves 6" to 18" long, narrowed to a short petiole, and 1 to 4 greenish-purple flowers on slender, spreading peduncles 6" to 12" long, fascicled in the axils. Corolla short-funnel-form, about 6" wide. Stamens slightly exserted. Berry oval, orange-red. May to Aug.

VII. DATŪRA, L. Herbs, or in the tropics sometimes shrubs or trees, of rank odor and strongly narcotic-poisonous properties, with large, entire, wavy-toothed, or lobed, petioled leaves, and large, solitary, white, violet, or purple flowers on short peduncles. Calyx prismatic or tubular, 5-toothed, deciduous in the species here given, with a persistent, orbicular, peltate base. Corolla funnel-form; limb plicate, 5-lobed. Stamens 5, included or slightly exserted; filaments long, filiform. Stigma 2-lipped; style long. Capsule ovoid or globular, generally prickly, 4-valved, 2-celled, or apparently 4-celled by the projection of the placentæ. About 12 species, widely distributed.

1. *D. Stramonium*, L. **STRAMONIUM. THORN APPLE. JAMESTOWN WEED.** A smooth, ill-scented annual, naturalized from tropical regions, probably Asia, as a weed in waste places especially about rubbish throughout our area, with a robust, *green*, forking stem, 2° to 3° high, ovate, sinuate-toothed or angled leaves 3' to 8' long, and erect, white flowers 3' to 4' long, with 5-toothed limb. Calyx prismatic, half as long as the corolla. Capsule erect, ovoid, about 2' long, covered with prickles, *the lower ones shorter*. The name *Jamestown Weed* arose from its abundance about the ruins of Jamestown, Va., and is usually corrupted to *Jimson*. June to Sept.

2. *D. Tatula*, L. **PURPLE-STEMMED THORN APPLE.** A plant naturalized from tropical America, similar to No. 1, of like habitat and range and more common westward, but taller and more slender, with *purple stem*, the flowers *bluish-white or pale violet-purple* and the *prickles on the capsule all about equal*. May to Sept.

ORDER 72. GENTIANACEÆ — GENTIAN FAMILY

Smooth herbs, rarely shrubs, with colorless, bitter juice, the exstipulate leaves, except in Suborder II, opposite, rarely whorled, simple, entire, usually sessile, generally ribbed, and regular, perfect, red, yellow, blue, white, or violet flowers, solitary or clustered, axillary or terminal. Calyx inferior, persistent. Corolla gamopetalous, funnel-form, bell-shaped, club-shaped, or rotate, mostly convolute

in bud, usually withering-persistent; its lobes alternate with the stamens inserted in its tube. Ovary free, 1-celled, with 2 parietal placentæ. Fruit usually a 2-valved, septical, many-seeded capsule. Embryo minute, in fleshy albumen.

More than 60 genera and nearly 600 species widely distributed, mostly of bitter- tonic, none of poisonous or nutritive properties.

Key to Genera

Suborder I. GENTIANEÆ. Leaves opposite or whorled, always simple and entire.

- a. Calyx of 2 sepals. A low, smooth herb, 3' to 6' high . . . **OBOLARIA** *
- a. Calyx 4-parted. Two small herbs. Leaves reduced to scales . . . **BARTONIA** *
- a. Calyx of as many divisions as the corolla. Leafy plants. (b)
- b. Corolla 4-parted, rotate. A central gland on each lobe . . . **FRASERA** *
- b. Corolla 4 to 5-cleft, bell-shaped. A spur on the back of each lobe **HALLENIA** *
- b. Corolla lobes without spurs or glands. (c)
- c. Corolla rotate; rose, pink, or white . . . **SABBATIA** 1
- c. Corolla tubular; rose, pink, white, or yellow . . . **ERYTHRÆA** *
- c. Corolla tubular; blue or white . . . **GENTIANA** 11

Suborder II. MENYANTHEÆ. Leaves all alternate. Marsh or aquatic plants.

- Leaves 3-foliate . . . **MENYANTHES** *
- Leaves simple, rounded . . . **LIMNANTHEMUM** *

* See flora of Britton, Gray, or Wood.

I. SABBATIA, ADANS. Atlantic, North American, biennial or annual herbs, with slender stems, opposite or verticillate leaves, and showy, pink or white, cymose-panicled flowers in summer or autumn. Calyx bell-shaped; tube usually short; limb of 5 to 12 narrow lobes. Corolla rotate, 5 to 12-parted. Stamens 5 to 12; anthers erect, at length recurved. Style slender, 2-cleft or -parted, deciduous. Capsule ovoid or globose. About a dozen species.

1. S. gracilis, SALISB. (*S. CAMPANULATA*, TORR.) **SLENDER MARSH PINK.** A plant found in brackish waters, low, grassy, pine barrens and meadows from Mass. to Pa., Fla., and La. and in the mts. of N.C. and Ga., with very slender, slightly angular stem, 1° to 2° high, long, slender, paniculate, or forking branches, linear or lance-linear leaves 12" to 18" long, about half as long as the internodes, the uppermost nearly filiform, the lowest shorter, and oblanceolate, and nearly solitary, terminal, pink flowers with a yellow eye. Corolla 12" to 14" wide, 5-parted, with oblong-obovate lobes, scarcely longer than the filiform segments of the calyx. Style 2-cleft to the middle. July, Aug.

2. S. angularis, PURSH. **SQUARE-STEMMED SABBATIA.** **BITTER BLOOM. ROSE PINK.** A plant found in rich soils, wet meadows, and prairies from N.Y. to Mich. south to Fla. and La., with rather stout, 4-angled and -winged, much-branched stem, 1° to 2° high, the branches opposite, numerous, ovate, acute, clasping, 8 to 5-nerved leaves 1' to 2' long, as long as the internodes, or often shorter, and numerous, deep pink or white flowers 15" to 18" wide, with a greenish, star-like center, usually solitary and terminal. Calyx segments linear, half as long as the corolla, with its obovate, obtuse lobes. Style 2-cleft to about the middle. July, Aug.

3. *S. Elliottii*, STEUD. (*S. PANICULATA*, ELL.) ELLIOTT'S SABBATIA. A common species, in low, pine barrens from N.C. to Fla., with terete, much-branched stem, 1° to 2° high, *branches alternate and diffuse*, small, linear, or subulate leaves 3" to 6" long, much shorter than the internodes, the lowest obovate, and numerous, solitary, and terminal, white flowers 1' wide. Calyx lobes filiform, 2 or 3 times as long as the tube, only half or a third as long as the 5 oblanceolate or spatulate lobes of the corolla. July to Sept.

II. *GENTIANA*, TOURN. GENTIAN. Herbs, mostly perennial, with dwarf, tufted, diffuse or erect, slender or stout stems, opposite, rarely whorled, mostly sessile leaves, and sessile, rarely peduncled, erect, blue, purple, violet, or rarely dull yellow or white flowers, terminal or axillary, solitary or clustered. Calyx tubular, 5 to 4-cleft or -parted. Corolla tubular, club-shaped, bell-shaped, or salver-form, 4 to 5-lobed, often with intermediate plaits or folds. Stamens 4 to 5, included. Style short or none. Stigmas 2, persistent. Capsule oblong, sessile or stiped, 2-valved, 1-celled, many-seeded.

A large genus embracing nearly 800 species, mostly of temperate and alpine regions.

Corolla without plaits between the lobes; lobes entire	No. 1
Corolla without plaits between the lobes; lobes fringed	No. 2
Corolla with plaits between the lobes; flowers never opening	No. 3
Corolla with plaits between the lobes; flowers opening	No. 4

1. *G. quinqueflora*, LAM. FIVE-FLOWERED GENTIAN. STIFF GENTIAN. AGUE WEED. An annual, of moist or dry soils from Me. to Mich. south to Fla. and Mo., with rather slender, usually branched, 4-angled stem, 1° to 2° high, ovate-lanceolate, acute, 3 to 5-nerved leaves 6" to 18" long, with partly clasping base, lower ones spatulate, obtuse, and blue, pediceled, axillary, and terminal flowers, *usually about 5 in a cluster*. Corolla tubular-funnel-form, 6" to 9" long, with 5 triangular-ovate, bristle-pointed, erect lobes. Calyx very short, with 5 linear, awl-shaped lobes. Capsule stiped. Var. *occidentalis*, GRAY, or *parviflora*, RAF., sometimes 2° to 3° high, with more broadly funnel-form corolla and larger calyx, its lance-linear, foliaceous lobes half as long as the corolla, is a common form from Ohio to Minn. south to Tenn. and La. Sept., Oct.

2. *G. crinita*, FROELICH. FRINGED GENTIAN. A handsome annual or biennial (?), of cool, low grounds and meadows and moist woods from Me. to the Dak. south to Iowa and Ohio, and in the mts. to Ga., with erect, branched stem, 1° to 2° high, lanceolate or ovate-lanceolate leaves 1' to 2' long, broad, rounded, or subcordate at base, tapering to the apex, and large, solitary, 4-parted, sky-blue, rarely white flowers, on long, terminal, erect peduncles. *Corolla tubular-bell-shaped, 2' long, with 4 spreading, wedge-obovate, strongly fringed lobes*. Calyx with 4-angled tube and 4 acuminate segments nearly equaling the tube of the corolla. Capsule spindle-shaped, stiped. Sept., Oct.

3. *G. Andrewsii*, GRISEB. CLOSED GENTIAN. BLIND OR BOTTLE GENTIAN. A common perennial, in moist soils from Me. to Minn. south to Ga. and Mo., with simple, stout, leafy stem, 1° to 2° high, ovate-lanceolate, acute or acuminate, 3 to 7-nerved leaves 2' to 4' long, narrow or rounded at base, rough on the margins, and erect, blue to purple flowers about 18" high, in a sessile or subsessile cluster at the top of the stem or sometimes also in smaller clusters in the axils below. *Corolla ventricous*.

club-shaped, closed or nearly so at the top, easily mistaken for a bud, its lobes truncate or obsolete, the intermediate plaits toothed, light-colored. Calyx 2-bracted, its lobes ovate-oblong, spreading, shorter than the top-shaped tube, and very much shorter than the corolla: Anthers cohering in a ring or tube. Capsule stiped. Seeds winged. Aug. to Oct.

4. *G. Saponaria*, L. SOAPWORT GENTIAN. BARREL GENTIAN. A perennial, of moist woods and soils from N.Y. and N.J. to Minn. south to Fla. and La., with slender, erect or ascending, simple or nearly simple stem, 1° to 2° high, ovate-lanceolate to lance-obovate, acutish, 3 to 5-nerved leaves 2' to 4' long, narrowed to a sub-clasping base, rough-margined, and light blue, erect flowers 18" to 24" high, in sessile, terminal, often axillary clusters. *Corolla club-bell-shaped or barrel-shaped; lobes obtuse, open, erect or convergent, distinct, longer than the cleft plaits. Calyx 2-bracted, its linear or spatulate lobes as long as the tube and half as long as the corolla. Anthers, capsules, and seeds as in No. 3. Aug. to Oct.*

ORDER 73. APOCYNACEÆ — DOGBANE FAMILY

Trees, shrubs, or herbs, with usually acrid, milky juice, exstipulate, entire, simple, mostly opposite leaves, and perfect, regular flowers. Calyx inferior, persistent; its lobes imbricate in bud. Corolla gamopetalous, the stamens alternate with its lobes, which are convolute in bud. Pollen granular. Ovary superior or nearly so, of two distinct carpels in our genera, with single style and stigma. Fruit generally 2 follicles or drupes. Seeds often appendaged with a tuft of hairs (comose).

An order mainly tropical, embracing 124 genera and about 1000 species (Warming).

Key to Genera

Erect herbs, with alternate leaves	AMSONIA *
Erect herbs, with opposite leaves	APOCYNUM 1
Cultivated, trailing, or exotic, erect herbs	VINCA 11
Woody, twining plants	TRACHELOSPERMUM *
Erect, exotic shrubs (Oleanders)	NERIUM *

* See flora of Gray, Britton, or Wood.

I. *APOCYNUM*, L. DOGBANE. Erect, perennial herbs, with branching stems, opposite, entire, mucronate leaves, and small, white or pink flowers on short pedicels, in terminal or axillary, corymbed cymes. Calyx very small, 5-parted. Corolla bell-shaped with triangular appendages within beneath the 5 lobes and alternate with the included stamens on short filaments from the base of the corolla. Anthers sagittate, convergent around and partly adherent to the large, sessile, ovoid, somewhat 2-lobed stigma. Fruit 2 slender, terete follicles 2' to 7' long. Seeds many, small, tipped with a long, silky tuft or coma.

1. *A. androsæmifolium*, L. SPREADING DOGBANE. HONEY BLOOM. A smooth or smoothish, widely spreading plant, 2° to 4° high, common in fields and borders of thickets from Me. to Dak. south to Ga. and Tex., with a horizontal rootstock, reddish stem, divergently forking branches, ovate or oval, distinctly petioled leaves 2' to 3' long, rounded at base, acute at apex, dark green above, pale beneath, and *pale pink flowers* on pedicels 2'' to 3'' long, in *loose, spreading*, terminal and axillary *cymes usually longer than the leaves*. Corolla open bell-shaped, 4'' wide, with *red stripes* and 5 acute, *revolute lobes*. Calyx much shorter than the corolla. Follicles 3' to 4' long. Pedicels bracted at base. July, Aug.

2. *A. cannabinum*, L. INDIAN HEMP. A smooth or slightly pubescent plant, common in moist grounds and on banks of streams from Me. to Dak. south to Fla. and Tex., with a deep, vertical root, upright stem, and ascending branches 2° to 3° high, oval to oblong or lanceolate, short-petioled or sessile leaves 2' to 4' long, and *greenish-white flowers in upright, close, many-flowered cymes usually shorter than the leaves*. Corolla about 3'' wide; *lobes nearly erect*; tube little if any longer than the calyx lobes. Follicles and pedicels as in No. 1. Variable. The common name refers to the tough, inner bark which characterizes both species. June to Aug.

II. *VINCA*, L. PERIWINKLE. Trailing or erect herbs or undershrubs, with juice scarcely milky, opposite leaves, and large, solitary and axillary, blue, white, or rose-colored flowers. Calyx 5-parted; lobes narrow. Corolla salver-form; tube cylindric or funnel-form; limb of 5, ample, oblique lobes. Stamens inserted above the middle of the tube, included. Two glands at the base of the ovary. Follicles 2, erect or divergent. Seeds not comose. Species 10 or 12, nearly all of the Old World.

1. *V. minor*, L. COMMON PERIWINKLE. A *hardy*, smooth, evergreen, European perennial, common in country gardens, running wild in cemeteries, and generally known by the misnomer "myrtle," with a *trailing, sterile stem, 1° to 2° long, rooting at the joints*, and sending up erect, flowering stems 3' to 6' high, shining, dark green, ovate or oblong-ovate, short-petioled leaves 1' to 2' long, with *smooth margin*, and slender-peduncled, solitary, blue flowers 1' wide, in a few of the axils. Corolla varying to white; its lobes wedge-shaped and obtusely truncate. *Calyx lobes smooth, lanceolate, one third as long as the corolla tube*. The name "periwinkle" is probably a corruption of the old Latin name, *pervinca*, by which, along with *vinca* as a variant form, Pliny designated the common species. April, May.

2. *V. major*, L. LARGER PERIWINKLE. A smooth, evergreen, European perennial, similar to No. 1, but *larger in all its parts, rooting only at the tips of its sterile stems and not quite hardy* in the northern U.S. Leaves ovate or subcordate-ovate, 2' to 3' long, with *ciliate margins*. *Calyx lobes ciliate, narrowly linear, as long as the corolla tube*. Corolla lobes obovate. Many varieties in cultivation. April, May.

3. *V. rosea*, L. MADAGASCAR PERIWINKLE. CAPE PERIWINKLE. OLD MAID. A house plant from tropical America and southern Fla., with erect, branching stem, 1° high, shrubby at the base, oblong, short-petioled leaves, and nearly sessile, rose-purple or white flowers 18'' to 24'' wide. The name "Madagascar" is misleading, as the only native species of that island is *V. lancea*, which is not found in cultivation. Blooms throughout the season.

ORDER 74. ASCLEPIADACEÆ—MILKWEED FAMILY

Perennial herbs or shrubs, mostly with milky juice, and with leaves, flowers, fruits, and seeds nearly as in *Apo-cynaceæ*, but with the corolla valvate in bud, the anthers more closely connivent around the stigma, their pollen aggregated, as in the *Orchidaceæ*, in granular or waxy masses, called *pollinia*, usually 10, the short filaments usually united into a tubular *column*, as it is sometimes called, and having between it and the corolla a 5-lobed or 5-parted appendage called the *crown* or *corona*, the 5 parts in some genera from their shape being called *hoods*. The *pollinium* or *pollen mass* is peculiar to this family and the *Orchidaceæ*.

The order embraces 204 genera and about 1700 species (Warming), widely distributed, mostly in warm regions.

Key to Genera

- a. Stems erect or merely decumbent. Pollinia 10, in pairs, pendulous. (b)
- a. Stems twining or trailing. (c)
- a. Stems low, fleshy, cactus-like. Leaves all radical. (e)
 - b. Corolla reflexed. Each hood inclosing a little horn **ASCLÉPIAS** I
 - b. Corolla merely spreading. Each hood inclosing a crest **ASCLEPIODORA** *
 - b. Corolla spreading or reflexed. Hoods hornless and crestless **ACERATES** *
- c. Pollinia 10, in pairs, pendulous. Corolla erect. Hoods 2-awned **ENSLÉNIA** *
- c. Pollinia 10, in pairs, horizontal. Corolla rotate. Crown a fleshy ring **GONOLOBUS** *
- c. Pollinia 10, in pairs, erect or ascending. Shrubby house plants. (d)
- c. Pollinia 5, each 4-lobed. Hardy, twining shrubs **PERÍPLOCA** *
- d. Corolla wheel-shaped **HÓYA** *
- d. Corolla salver-shaped **STEPHANÓTIS** *
- e. Pollinia 10, erect. Flowers lurid. Cultivated **STAPELIA** *

* See floras of Wood, Gray, Britton, etc.

I. ASCLÉPIAS, L. MILKWEED. SILKWEED. Perennial herbs, with deep, thick roots, erect, ascending, or decumbent stems, opposite, whorled, or alternate, entire leaves, and simple, many-flowered umbels on terminal or lateral peduncles, the latter usually between the opposite petioles. Calyx 5-parted or -divided, reflexed, persistent. Corolla deeply 5-parted, reflexed, deciduous. Stamens 5, inserted on the base of the corolla; filaments short, united in a ring or tube (*column*); anthers broad, encircling and partly adhering to the thick, discoid, 5-angled stigma, sometimes with an inflexed or erect appendage over it. The staminal tube bears outside each anther a petaloid body called a *hood*, inclosing a small, usually incurved *horn*. Anther cells 2, vertical, each inclosing a pear-

shaped, waxy pollen mass (*pollinium*), which by a slender prolongation of the top is attached to a sticky, cleft gland on the stigma between two adjacent anthers of separate stamens; the gland thus supporting a pair of pollinia, which are drawn out with it by the legs of insects. Ovaries 2, free; styles short, connected above by a single stigma. Follicles 2, ovate or lanceolate, one often abortive. Seeds flat, margined, comose. About 85 species, mostly American.

- a. Flowers greenish, yellowish, white, or purplish tinged. (b)
- a. Flowers bright red or purple. Leaves opposite, mostly broad Nos. 7, 8
- a. Flowers orange or orange-red. Leaves scattered No. 9
- b. Follicles woolly, armed with soft, spiny processes Nos. 1, 2
- b. Follicles unarmed. Umbels solitary. Leaves sessile, broad, wavy No. 3
- b. Follicles unarmed. Umbels usually more than one. (c)
- c. Leaves broad Nos. 4, 5
- c. Leaves narrowly linear and filiform No. 6

1. *A. Cornuti*, DECAISNE. (*A. SYRIACA*, L.) COMMON MILKWEED.

A very milky, weed-like plant, common in fields and waste places from Me. to Minn. south to N.C. and Kan., with stout, erect, finely pubescent, usually simple stem, 2° to 4° high, pale, oblong-oval, short-petioled, opposite leaves 4' to 8' long, downy beneath, and very numerous, greenish-purple or whitish flowers on slender pedicels 1' to 2' long, in globular umbels, on downy, terminal and lateral peduncles 2' to 3' long. Hoods ovate, toothed on each side; horns short, stout, much incurved. Pods very few, ovate, acuminate, 3 to 5' long, erect on reflexed pedicels, full of silky seeds. June to Aug.

2. *A. Sullivantii*. SULLIVANT'S MILKWEED. A very smooth plant, of low, moist soils from Ohio to Minn., Neb., and Kan., with usually simple stem, 1° to 2° high, thick, ovate-oblong, erect, cordate, short-petioled or sessile, opposite leaves, and purplish flowers in a solitary umbel on a terminal peduncle 3' to 6' long. Hoods obovate, obtuse, entire, 2-eared at the base without, and longer than the incurved horn. Pods erect, narrow, 4' to 5' long, smooth, spiny mainly at the top. July to Sept.

3. *A. obtusifolia*, Mx. BLUNT-LEAVED MILKWEED. A pale green, slightly glaucous plant, of dry soils, sandy woods, and fields from Me. to Minn. south to Fla. and Tex., with erect, simple stem, 2° to 3° high, oblong, obtuse, mucronate, sessile, cordate, somewhat clasping leaves 4' to 5' long, wavy-cripsed on the margins, very smooth on both sides, and numerous, greenish-purple flowers in a solitary umbel on a naked, terminal peduncle 3' to 12' long, or rarely with a second umbel on a shorter peduncle from its base. Hoods nearly white, almost truncate, toothed, shorter than the slender, inflexed horn. Pods downy, 4' to 6' long, erect, on decurved pedicels. June to Sept.

4. *A. phytolaccoides*, Ph. POKE-LEAVED MILKWEED. TALL MILKWEED. A tall, rather handsome plant, nearly smooth throughout, common in low, moist, shady grounds from Me. to Minn. south to Ga. and Mo., with erect, simple stem, 3° to 5° high, thin, opposite, often glaucous, ovate, oval, or oblong, short-petioled leaves 4' to 8' long, tapering at both ends, and numerous flowers on slender pedicels 1' to 3' long, in several, lateral, long-peduncled umbels near the top. Corolla lobes ovate-oblong, greenish; hoods white, tinged with pink, truncate, entire or 2 to 4-toothed at summit, shorter than the subulate, exserted, nearly erect horns. June to Aug.

5. *A. variegata*, L. WHITE MILKWEED. A plant, of dry woods and

thickets from Conn. and southern N.Y. to Ill. south to Fla., Ark., and La., with smoothish, erect, simple stem, 2° to 3° high, thick, ovate, oval, or obovate, short-petioled, opposite leaves 3' to 6' long, middle ones sometimes whorled in 4's, and numerous, white flowers in crowded umbels on short, downy, lateral or terminal peduncles. Corolla lobes ovate; hoods orbicular, entire, about equaling the broadly falcate horn with horizontal apex. Pods downy, 4' to 5' long, erect, on deflexed pedicels. June, July.

6. *A. verticillata*, L. WHORLED MILKWEED. A slender plant, common in dry fields, or in swamps and meadows throughout our area, with simple or sparingly branched stem, 1° to 3° high, pubescent in lines, narrowly linear, sessile leaves 2' to 4' long, mostly in whorls of 3 to 6, revolute on the margins, and several small, many-flowered, terminal and lateral umbels on peduncles longer than the pedicels. Corolla greenish-white; hoods white, broadly ovate, shorter than the falcate, exserted, incurved horns. Pods slenderly spindle-shaped, 2' to 3' long, smooth, erect, on erect pedicels. July to Sept.

7. *A. quadrifolia*, L. FOUR-LEAVED MILKWEED. A neat plant, common in dry woods and thickets from Me. to Minn. south to N.C. and Ark., with smooth, slender, erect, simple stem, 1° to 2° high, generally leafless below, thin, smooth, ovate or ovate-lanceolate, acuminate, short-petioled leaves 2' to 4' long, *the middle ones usually in whorls of 4*, the rest opposite, the lowest pair much smaller, and small, pale pink and white flowers, in 2 to 4 loose umbels on slender, terminal or axillary peduncles 1' to 3' long; the slender pedicels about half as long. *Corolla lobes pale pink, 2'' to 3'' long; hoods white, elliptic-ovate, longer than the short, thick, incurved horns.* Pod smooth, 3' to 5' long, erect, on erect peduncles. May to July.

8. *A. incarnata*, L. SWAMP MILKWEED. A very leafy plant, of swamps and wet places from Canada to Tenn. and La., with branching stem, 3° to 4° high, usually smooth except for 2 downy lines, opposite, lanceolate or oblong-lanceolate, acuminate leaves 3' to 6' long, on short petioles, and small, rose-purple (*incarnata*) flowers in 2 to 6 erect, mostly terminal and corymbed umbels. Hoods paler than the corolla, obtuse, shorter than the slender, incurved horn. Pods 2' to 3' long, erect, on erect or ascending pedicels. Var. *pulchra*, PERS., HAIRY MILKWEED, with taller stem, broader and shorter-petioled leaves, and both stem and leaves hairy-pubescent or tomentose, with scanty, milky juice, occurs with the smooth form. July to Sept.

9. *A. tuberosa*, L. ORANGE MILKWEED. BUTTERFLY WEED. PLEURISY ROOT. A rough-hairy plant, of dry fields throughout our area, especially common southward, with rather stout, *very leafy stems*, 1° to 2° high, branching somewhat near the top, erect, or ascending in a *bushy cluster* from large, fleshy roots, *alternate*, oblong-lanceolate leaves 2' to 5' long, sessile or short-petioled, and numerous umbels of *bright orange or orange-red flowers* in *large, terminal corymbs*, making a gorgeous mass visible many rods away. Hoods erect, oblong. Var. *decumbens*, PR., occurring from Ohio to Ill. south to N.C., Ga., and Fla., has *decumbent stems*, broader leaves, *upper ones opposite* and smaller, and the *umbels racemed* along the branches, one in each axil. June to Aug.

ORDER 75. OLEACEÆ — OLIVE FAMILY

Trees or shrubs, with opposite, rarely alternate, simple or pinnate, entire or toothed, exstipulate leaves, and regular, perfect, diœcious or polygamous flowers. Calyx

oiled leaves 4' to 6' long, and pale blue or white flowers 9" to 12" wide, in simple, slender, at first terminal but finally lateral racemes. Calyx lobes acuminate, half as long as the corolla, persistent beneath the smooth, globous, yellow berry 6" to 10" in diameter. June to Sept.

5. *S. rostratum*, DUNAL. SAND BUR. BEAKED NIGHTSHADE. A very prickly, stellate-pubescent, yellowish, or hoary annual, of prairies west of the Mississippi, but now spreading eastward to Ill., Tenn., and Ga., with erect, branching stem, 1° to 2° high, ovate or oval, irregularly and pinnately lobed, or 1 to 2-pinnatifid, petioled leaves 2' to 5' long, and yellow flowers 1' wide, on stout, erect pedicels 3" to 6" long, in lateral racemes. Corolla nearly regular; lobes 5, broadly ovate, acute. Lowest stamen longer than the others and incurved or *beaked* (*rostratum*). *Calyx densely armed with straight, sharp prickles* as long as the wholly inclosed berry. Fruit inclusive of prickles 1' or more in diameter. May to Sept.

III. *PHYSALIS*, L. GROUND CHERRY. Annual or perennial herbs, chiefly American, with entire, toothed, or lobed leaves, and white, yellow, or violet-purple flowers on slender peduncles, in our species solitary and axillary. *Calyx bell-shaped, 5-cleft; in fruit much enlarged, membranous and inflated like a bladder* (whence the generic name), 5-angled, 10-ribbed, *wholly enveloping the globular, 2-celled, pulpy berry*. Corolla rotate or rotate-campanulate, plicate in bud, with very short tube and 5-angled or obscurely 5-lobed limb. Stamens 5, erect.

1. *P. pubescens*, L. HUSK OR STRAWBERRY TOMATO. DOWNY GROUND CHERRY. A strong-scented, downy or woolly, viscid, or sometimes nearly smooth annual, of low grounds, sandy soils, and damp, shady places from N.Y. to Minn. south to Fla. and Tex., and often cultivated for its fruit, with diffusely branching, trailing, or at length ascending stem, 9' to 12' or 20' high, cordate or ovate, angularly or repandly toothed, or nearly entire leaves, unequal at base, 2' to 4' long, on long petioles, in pairs on the flowering branches, and yellow flowers 4" to 7" wide, with dark center, and blue, violet, or purplish anthers. Berry greenish-yellow, very sweet, loosely enveloped by the ovate-pyramidal, 5-angled, and keeled calyx. Aug., Sept.

2. *P. Alkekengi*, L. ALKEKENGİ. EUROPEAN STRAWBERRY TOMATO. WINTER CHERRY. A perennial, of southeastern Europe and Asia as far as Japan, cultivated for its ornamental fruit and somewhat escaped in the Eastern States, with pubescent, angled, zigzag, mostly simple stem, 12' to 18' high, triangular-ovate, acuminate, repand leaves, attenuated to a long petiole, making them 3' to 4' long, and white flowers with yellow anthers. Berry globular, red, edible, sweet, inclosed in the large, bright red, ovoid-globous calyx. July.

IV. *NICÁNDRA*, ADANS. A smooth, Peruvian annual, with erect, branching stem, 2° to 4° high, thin, alternate, ovate-oblong, sinuate-dentate, or lobed, petioled leaves 4' to 7' long, and showy, blue or purple, peduncled, nodding, solitary, axillary flowers 12" to 18" long. Calyx 5-parted, 5-angled, segments sagittate, enlarging in fruit and inclosing the 3 to 5-

celled, dry, globular berry. Corolla bell-shaped, with border nearly entire. Otherwise nearly the same as *Physalis*. Genus monotypic.

1. *N. physaloides*, ADANS. APPLE OF PERU. A plant resembling a *physalis* in aspect and fruit (whence its specific name), and a *stramonium* in its leaves, common in old gardens and escaped to waste places and fields from Me. to Fla. Fruit about 6" in diameter, loosely inclosed by the 5-winged calyx. July to Sept.

V. *PETUNIA*, JUSS. *PETUNIA*. Annual or perennial, usually clammy-pubescent, branched herbs, cultivated as ornamental annuals, with entire leaves, and usually large, axillary or terminal, solitary, violet-purple or white flowers. Calyx 5-parted, segments oblong-spatulate. Corolla funnel-form or salver-form; limb spreading, obscurely 5-lobed. Stamens 5, inserted near the middle of the tube, *unequal*, included. Anthers cordate. Stigma capitate. Capsule 2-celled, 2-valved. Seeds minute.

About a dozen species, natives of South America. The two below and their hybrids are the parents of the many cultivated varieties.

1. *P. nyctagyniflora*, JUSS. A clammy-pubescent perennial, of southern Brazil and Argentina, common in old gardens and somewhat escaped in N.Y. and Pa., with rather stout and erect, branching stem, 1° or more high, ovate-oblong, obtuse leaves 3' to 4' long, sessile, or lower ones narrowed to a petiole, upper ones smaller and subopposite, and *white flowers 12" to 18" long*, on slender, solitary *peduncles usually longer than the leaves*. Corolla tube cylindric, slightly enlarged above, 3 times as long as the calyx; limb wide-spreading, nearly 2' across; lobes rounded. Strong-scented in the evening. July to Sept.

2. *P. violacea*, LINDL. A species similar to the preceding, from the same region and similarly escaped from old gardens, but with lower, weaker, and more slender stem, prostrate at the base, then ascending or erect, ovate, acute, short-petioled leaves, the upper ovate-lanceolate, and *violet-purple flowers 9" to 15" long*, on solitary *peduncles equaling the leaves*. Corolla tube bell-shaped, the limb spreading less abruptly than in No. 1, 12" to 18" wide, the lobes somewhat acute. Rarely found now in a pure form. June to Sept.

VI. *LÝCIUM*, L. Trailing, climbing, or spreading shrubs, often spiny, with alternate, usually entire, short-petioled leaves, often with also smaller, fascicled ones, and whitish, greenish, violet, or purple, solitary or clustered, axillary or terminal flowers. Calyx 3 to 5-cleft or -toothed, persistent. Corolla funnel-form, salver-form, or bell-shaped; tube short; limb usually 5-lobed, spreading. Stamens 5 or 4; anthers opening lengthwise. Ovary 2-celled; style slender; stigma capitate. Fruit a small berry.

About 70 species, widely distributed in warm and temperate regions.

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III. *PHYSALIS*, L. GROUND CHERRY. Annual or perennial herbs, chiefly American, with entire, toothed, or lobed leaves, and white, yellow, or violet-purple flowers on slender peduncles, in our species solitary and axillary. *Calyx bell-shaped, 5-cleft; in fruit much enlarged, membranous and inflated like a bladder* (whence the generic name), 5-angled, 10-ribbed, *wholly enveloping the globular, 2-celled, pulpy berry*. Corolla rotate or rotate-campanulate, plicate in bud, with very short tube and 5-angled or obscurely 5-lobed limb. Stamens 5, erect.

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III. *PHYSALIS*, L. GROUND CHERRY. Annual or perennial herbs, chiefly American, with entire, toothed, or lobed leaves, and white, yellow, or violet-purple flowers on slender peduncles, in our species solitary and axillary. *Calyx bell-shaped, 5-cleft; in fruit much enlarged, membranous and inflated like a bladder* (whence the generic name), 5-angled, 10-ribbed, wholly enveloping the globular, 2-celled, pulpy berry. Corolla rotate or rotate-campanulate, plicate in bud, with very short tube and 5-angled or obscurely 5-lobed limb. Stamens 5, erect.

1. *P. pubescens*, L. HUSK OR STRAWBERRY TOMATO. DOWNY GROUND CHERRY. A strong-scented, downy or woolly, viscid, or sometimes nearly smooth annual, of low grounds, sandy soils, and damp, shady places from N.Y. to Minn. south to Fla. and Tex., and often cultivated for its fruit, with diffusely branching, trailing, or at length ascending stem, 9' to 12' or 20' high, cordate or ovate, angularly or repandly toothed, or nearly entire leaves, unequal at base, 2' to 4' long, on long petioles, in pairs on the flowering branches, and yellow flowers 4" to 7" wide, with dark center, and blue, violet, or purplish anthers. Berry greenish-yellow, very sweet, loosely enveloped by the ovate-pyramidal, 5-angled, and keeled calyx. Aug., Sept.

2. *P. Alkekengi*, L. ALKEKengi. EUROPEAN STRAWBERRY TOMATO. WINTER CHERRY. A perennial, of southeastern Europe and Asia as far as Japan, cultivated for its ornamental fruit and somewhat escaped in the Eastern States, with pubescent, angled, zigzag, mostly simple stem, 12' to 18' high, triangular-ovate, acuminate, repand leaves, attenuated to a long petiole, making them 3' to 4' long, and white flowers with yellow anthers. Berry globular, red, edible, sweet, inclosed in the large, bright red, ovoid-globous calyx. July.

IV. *NICÁNDRA*, ADANS. A smooth, Peruvian annual, with erect, branching stem, 2° to 4° high, thin, alternate, ovate-oblong, sinuate-dentate, or lobed, petioled leaves 4' to 7' long, and showy, blue or purple, peduncled, nodding, solitary, axillary flowers 12" to 18" long. Calyx 5-parted, 5-angled, segments sagittate, enlarging in fruit and inclosing the 3 to 5-

celled, dry, globular berry. Corolla bell-shaped, with border nearly entire. Otherwise nearly the same as *Physalis*. Genus monotypic.

1. *N. physaloides*, ADANS. APPLE OF PERU. A plant resembling a *physalis* in aspect and fruit (whence its specific name), and a *stramonium* in its leaves, common in old gardens and escaped to waste places and fields from Me. to Fla. Fruit about 6" in diameter, loosely inclosed by the 5-winged calyx. July to Sept.

V. *PETUNIA*, JUSS. *PETUNIA*. Annual or perennial, usually clammy-pubescent, branched herbs, cultivated as ornamental annuals, with entire leaves, and usually large, axillary or terminal, solitary, violet-purple or white flowers. Calyx 5-parted, segments oblong-spatulate. Corolla funnel-form or salver-form; limb spreading, obscurely 5-lobed. Stamens 5, inserted near the middle of the tube, *unequal*, included. Anthers cordate. Stigma capitate. Capsule 2-celled, 2-valved. Seeds minute.

About a dozen species, natives of South America. The two below and their hybrids are the parents of the many cultivated varieties.

1. *P. nyctagyniflora*, JUSS. A clammy-pubescent perennial, of southern Brazil and Argentina, common in old gardens and somewhat escaped in N. Y. and Pa., with rather stout and erect, branching stem, 1° or more high, ovate-oblong, obtuse leaves 3' to 4' long, sessile, or lower ones narrowed to a petiole, upper ones smaller and subopposite, and *white flowers* 12" to 18" long, on slender, solitary *peduncles usually longer than the leaves*. Corolla tube cylindric, slightly enlarged above, 3 times as long as the calyx; limb wide-spreading, nearly 2' across; lobes rounded. Strong-scented in the evening. July to Sept.

2. *P. violacea*, LINDL. A species similar to the preceding, from the same region and similarly escaped from old gardens, but with lower, weaker, and more slender stem, prostrate at the base, then ascending or erect, ovate, acute, short-petioled leaves, the upper ovate-lanceolate, and *violet-purple flowers* 9" to 15" long, on solitary *peduncles equaling the leaves*. Corolla tube bell-shaped, the limb spreading less abruptly than in No. 1, 12" to 18" wide, the lobes somewhat acute. Rarely found now in a pure form. June to Sept.

VI. *LÝCIUM*, L. Trailing, climbing, or spreading shrubs, often spiny, with alternate, usually entire, short-petioled leaves, often with also smaller, fascicled ones, and whitish, greenish, violet, or purple, solitary or clustered, axillary or terminal flowers. Calyx 3 to 5-cleft or -toothed, persistent. Corolla funnel-form, salver-form, or bell-shaped; tube short; limb usually 5-lobed, spreading. Stamens 5 or 4; anthers opening lengthwise. Ovary 2-celled; style slender; stigma capitate. Fruit a small berry.

About 70 species, widely distributed in warm and temperate regions.

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About 70 species, widely distributed in warm and temperate regions.

- b. Scattered, linear, flat, in two rows opposite on the twigs. Cones pendulous, maturing the first year; scales thin, persistent, without conspicuous bracts. **TSUGA. Hemlock**
- b. Scattered, linear, 4-sided, in several rows on the twigs. Cones pendulous, etc., as in *Tsuga*. **PICEA. Spruces**
- b. Scattered, linear, flat, somewhat in 2 rows, the midrib keeled beneath. Cones erect, the thin scales subtended by conspicuous, awned or mucronate bracts and deciduous when mature. Bark smooth, with balsam-bearing blisters. **ABIES. Fir or Balsam Fir**
- b. Scale-like, small, appressed, 4-ranked. (c)
 c. Cones ovoid or oblong; scales few, oblong. **THUJA. Arbor Vitæ**
 c. Cones globose. Scales peltate, bossed in the center, **CHAMÆCYPARIS. White Cedar**
- b. Awl-shaped, rigid and spreading; or scale-like and appressed; the cone berry-like. **JUNIPERUS. Juniper and Red Cedar**
- d. Fascicled, in rosette-like clusters of 12 to 20. **LARIX. Larch**
- d. Linear, sessile in 2 rows. **TAXODIUM. Bald Cypress**
- Suborder II. TAXACEÆ. YEW SUBFAMILY.** Fruit drupe-like. Leaves linear, or in one exotic genus, *Ginkgo*, fan-shaped. (e)
- a. Leaves evergreen, linear. Fruit solitary, a blackish, nut-like seed, seated in the bottom of a red, fleshy cup. A low or prostrate shrub with foliage resembling the common Hemlock. **TAXUS. Dwarf Yew. Ground Hemlock**
- a. Leaves evergreen, linear, arranged as in the Yew, but longer and tapering to a slender point. Fruit a thin-fleshed, oval drupe or dry nut, resembling a nutmeg in size and interior structure. **TORREYA. Stinking Cedar**

CLASS II. MONOCOTYLÉDONS OR ÉNDOGENS

Phænogamous plants, whose stems, with no clear distinction of bark, wood, and pith, and, accordingly, when perennial with no annual layers, are composed of thread-like bundles of vessels and woody fiber embedded in the general cellular tissue, hence called *Endogens*, and whose embryo has but one cotyledon, hence called *Monocotyledons*. The leaves are mostly parallel-veined, with sheathing base, rarely separating by a joint, and mostly alternate or scattered.

§ V. SPADICEOUS PLANTS

Flowers collected on a fleshy axis called a *spadix*, which is usually enveloped or subtended by a kind of bract call a *spathe*, without calyx or corolla except in some *Araceæ* and *Naiadaceæ*, and the leaves sometimes netted-veined.

ORDER 80. ARACEÆ—ARUM FAMILY

Herbs with tuberous rootstock or corm, or sometimes a fibrous root, in our species generally characterized by an

acid or pungent juice, simple or compound, radical, usually long-petioled, often netted-veined leaves, and perfect or imperfect, apetalous or naked flowers on a spadix, which is usually enveloped or subtended by a spathe. Calyx when present of 4 to 6 scale-like sepals. Stamens hypogynous, with short filaments, 4 to 10 in our species. Ovary free. Stigma usually sessile. Fruit a berry or dry.

About 100 genera and 900 species are recognized (Warming), mostly tropical, especially in South America, India, and the Indian Islands.

Key to Genera

- § Spadix enveloped by a spathe. (a)
 - a. Flowers only on the base of the spadix **ARISÆMA** I
 - a. Flowers covering the whole spadix, and (b)
 - b. Monœcious, naked; stamens above **PELTANDRA** *
 - b. Perfect, naked. Spathe open, white **CALLA** *
 - b. Perfect, with calyx. Spathe covering the spadix **SYMPLOCARPUS** II
- § Spadix naked, i.e. without a spathe. (c)
 - c. Spadix yellow, terminating the terete scape **ORONTIUM** III
 - c. Spadix greenish, lateral, on a leaf-like scape **ACORUS** IV

* See floras of Britton, Gray, Wood, etc.

I. ARISÆMA, MARTINS. Perennial herbs, with a tuberous rootstock or corm, 1 to 3 netted-veined, radical, usually compound leaves on long, sheathing petioles, and a simple scape terminating in a conspicuous spathe, convolute below and often arched above, which envelopes an exserted or included spadix, naked and elongated above, and bearing near its base monœcious or diœcious, naked flowers. Staminate flowers, above the pistillate when both are present, each consisting of 4 nearly sessile, 2 to 4-celled anthers, opening at the top. Pistillate flowers, each a 1-celled ovary, containing 2 to 6 orthotropous ovules, erect from the base of the cell. Stigma depressed. Fruit a 1 to few-seeded, red berry.

About 60 species, widely distributed.

1. A. triphyllum, TORR. INDIAN TURNIP. JACK-IN-THE-PULPIT. A stemless herb, common in moist woods and thickets from Me. to Minn. and Kan. south to Fla. and La., with an acid, fleshy, wrinkled, turnip-shaped corm, an erect, terete scape 6' to 12' high, and usually 2 trifoliate leaves sheathing the scape below with their long petioles; their leaflets elliptic-ovate, acute, or acuminate, entire, and usually sessile. Spathe green, striped with purple, ovate, acuminate, its upper part curving like a pulpit sounding-board over the top of the club-shaped, exserted spadix, and the lower convolute, tubular part concealing the yellow, usually diœcious flowers. Fruit a bunch of scarlet berries. The corm loses its acidity by boiling or drying. April to June.

II. SYMPLOCÁRPUS, SALISB. (*SPATHYEMA*, RAF.) A perennial herb, of skunk-like and somewhat garlicky odor, with a thick rootstock, a short, erect scape, scarcely rising out of the ground, a thick, fleshy, hood-like spathe and its inclosed oval or globular spadix appearing in the earliest spring, and, later on, a cluster of large, broad, entire, netted-veined leaves. Sepals 4, hooded. Stamens 4, opposite the sepals; anthers 2-celled, extrorse, opening lengthwise. Ovary 1-celled, 1-ovuled, tipped with a pyramidal, 4-angled style and a small stigma. Berries globose, roughened on top by the persistent sepals and style, inclosing a spherical seed, all immersed in the fleshy spadix, and forming with it a sorosis-like fruit when the spathe decays. A monotypic genus of eastern North America, northeastern Asia, and Japan.

1. *S. fétidus*, NUTT. SKUNK CABBAGE. A well-known plant, common in bogs, meadows, and wet grounds from Me. to Minn. and Iowa south to Fla., with bright green, ovate, cordate, acute, strongly nerved, short-petioled leaves 1° to 2° long, and perfect, apetalous, immersed flowers completely covering the spadix about 1' in diameter. Spathe 3' to 6' high, shell-shaped, incurved, pointed, purplish-brown to greenish-yellow, often spotted or mottled. Fruit in autumn, 2' to 3' in diameter, shedding in decay its bullet-like seeds 4'' to 6'' in diameter. Feb. to April.

III. ORÓNTIUM, L. A stemless, aquatic, perennial herb, with a thick, deep rootstock, elliptic-lanceolate, entire, parallel-veined, long-petioled leaves, and a slender, terete, elongated scape, invested toward the base by a short leaf-sheath in lieu of a spathe, and terminated by a cylindrical spadix completely covered with bright, golden-yellow, apetalous, perfect flowers. Stamens and concave sepals 4 or 6, usually 4 in the upper flowers and 6 in the lower. Ovary 1-celled, 1-ovuled; stigma sessile. Fruit a green utricle. Seed without albumen.

A monotypic genus of Atlantic North America.

1. *O. aquáticum*, L. GOLDEN CLUB. A handsome plant, common in ponds and other still, sometimes running waters 10' to 18' deep, from Mass. to central Pa. south to Fla. and La., mostly near the coast, with floating or ascending leaves, according to the depth of the water, on radical petioles 4' to 20' long, the blades dark green and velvet-like above, silvery beneath, 6' to 12' long, and a decumbent, white scape 1° to 2° long, thickening upward to the spadix, which is 2' to 3' long and 3'' to 4'' in diameter, usually projecting out of the water. April to May.

IV. ÁCORUS, L. Perennial herbs, with long, creeping, jointed, fleshy, aromatic rootstocks, the calamus of the drug stores, radical, sword-shaped leaves, and somewhat similar

scapes, bearing on one edge a cylindric spadix densely and completely covered with minute, greenish-yellow, apetalous, perfect flowers. Stamens and concave sepals 6. Ovary 2 to 4-celled, with several ovules in each cell. Fruit a dry, 2 to 3-celled, several-seeded berry, gelatinous inside.

Only 2 known species, the one below widely distributed, and one of China and Japan.

1. *A. Calamus*, L. SWEET FLAG. CALAMUS. A plant found in swamps, wet grounds, and along streams from Me. to Minn. south to Fla. and La., with erect, linear, 2-edged, sharply pointed leaves 2° to 3° high, 1' or less in width, a ridged midrib running their whole length, 2-ranked and sheathing each other as well as the scape below. Spadix 2' to 3' long, about 3'' in diameter, the scape projecting 1° to 2° above it and regarded by some as an open spathe. May to July.

§ VI. PETALOIDEOUS PLANTS

Flowers containing petals or their equivalents and not on a spadix.

ORDER 81. ALISMACEÆ — WATER-PLANTAIN FAMILY

Marsh or aquatic herbs, with fibrous roots, scape-like stems, long-petioled, parallel-veined, radical leaves, and perfect, monœcious or diœcious flowers, with regular calyx and corolla, in loose racemes or panicles, on long, mostly whorled pedicels subtended by bracts. Sepals 3, green, persistent. Petals 3, colored, often large, deciduous. Stamens 6 or more. Ovaries distinct, few or many, 1-celled, usually 1-ovuled, becoming in our species akenes in fruit.

About 12 genera and 60 species, widely distributed in fresh waters.

Key to Genera

- a. Flowers perfect. (b)
 b. Carpels in a circle, on a flat receptacle. Stamens 6 *ALISMA* I
 b. Carpels in a head. Stamens 9 to 24 *ECHINODORUS* #
 a. Flowers monœcious or diœcious. Carpels in a head *SAGITTARIA* II

* See floras of Gray, Wood, Britton, etc.

1. *ALISMA*, L. Stemless, marsh herbs, mostly perennial, with ribbed leaves, and small, white or pale pink, perfect flowers. Petals involute in bud. Stamens usually 6. Ovaries many, arranged in a ring, becoming in fruit as many, flat, keeled or ribbed akenes.

About 10 species, widely distributed.

1. **A. Plantago**, L. **WATER PLANTAIN**. A smooth, perennial herb, common in ponds, ditches, and shallow water throughout our area and around the globe, with long-petioled, radical, ovate, oval or lanceolate, acute leaves, rounded or subcordate at base, 3 to 9-ribbed, like those of the common plantain, the ribs connected by cross veinlets, and a loose, compound-panicled scape 1° to 2° high, of numerous, small, pinkish-white flowers on whorled pedicels bracted at the base. Petioles 8' to 12' long. Akenes 15 to 20, obliquely obovate, forming together an obtusely triangular, truncate whorl. Foliage variable. June to Sept.

II. SAGITTARIA, L. **ARROWHEAD**. Stoloniferous, marsh or aquatic herbs, mostly perennial, with milky juice, tuber-bearing or knotted rootstocks, fibrous roots, usually arrow-shaped, often lanceolate or linear leaves, ribbed and cross-veinleted as in *Alisma*, sheathing by the bases of their long petioles the bases of the scapes, or reduced to mere flat petioles (phyllodia), and mostly monœcious, rarely diœcious or polygamous, pediceled flowers in bracted whorls of 3's near the summit of the scapes, the sterile ones usually above the others. Sepals 3. Petals 3, larger, colored, imbricate in bud. Stamens usually many, rarely few. Ovaries very many, crowded in a globose head, becoming in fruit flat, margined akenes.

About 25 species, in temperate and tropical regions.

1. **S. variabilis**, ENGELM. (*S. LATIFOLIA*, WILLD.) **COMMON ARROWHEAD**. A very common aquatic, conspicuous among the rushes and sedges in water and wet places throughout our area, very variable in size and foliage, but usually with sagittate leaves, angled scape, the *upper flowers sterile, on pedicels about twice as long as those of the lower fertile ones, the filaments smooth, longer than the anthers, and the akenes obovate, about 1" long, with a conspicuous, averted beak*. Flowers often diœcious. Petals roundish, conspicuous, wholly white. For varieties, *obtusa*, *latifolia*, *angustifolia*, *diversifolia*, *pubescens*, etc., some of them treated by some botanists as distinct species, consult the floras of Gray, Wood, and Britton. July to Sept.

ORDER 82. AMARYLLIDACEÆ — AMARYLLIS FAMILY

Perennial herbs, chiefly bulbous, with linear or narrow, entire, radical leaves, and perfect, mostly regular flowers on scapes; the lobes of the 6-parted, colored perianth imbricate in the bud, and the tube adherent to the 3-celled ovary. Stamens 6, anthers introrse. Style 1. Fruit a 3-celled capsule or berry, several, many-seeded. Embryo straight, in fleshy albumen.

About 70 genera and 650 species, chiefly of warm regions.

Key to Genera

- a. Perianth with a crown at the top of the tube. (b)
 b. Crown a thin membrane connecting the stamens **PANCRATIUM** *
 b. Crown a firm cup including the stamens **NARCISSUS** I
- a. Perianth without a crown. (c)
 c. Segments united into a tube above the ovary. (d)
 d. Flower solitary **ZEPHYRANTHES** II
 d. Flowers many. Perianth tube straight **AGAVE** *
 d. Flowers many. Perianth tube curved **POLIANTHES** *
 c. Segments distinct down to the ovary. (e)
 e. Perianth irregular **SPRECKELIA** *
 e. Perianth regular. (f)
 f. Outer segments wholly white, longer than the inner **GALANTHUS** III
 f. Outer segments green-tipped, no longer than the inner **LEUCOCIUM** *
 f. All the segments about equal, yellow **HYPOXIS** IV
- * See floras of Wood's Class Book of Botany and Gray's Field, Forest, and Garden Botany.

I. NARCISSUS, L. Ornamental, Old World, bulbous plants, with linear or strap-shaped leaves, and white or yellow, solitary or umbelled flowers from a scarious, 1-leaved, deciduous spathe on a scape. Perianth salver-form, with 6-parted limb, and at the top of the tube a cup- or saucer-shaped crown (corona) consisting of a whorl of united, sterile stamens. Proper or fertile stamens 6, inserted in the tube and included. Ovary, etc., as in the family.

About 20 species, mostly of the Mediterranean region.

- § Crown longer than the tube of the perianth Nos. 1, 2
 § Crown shorter than the tube of the perianth. (b)
 b. Leaves subterete. 2 to 8 flowers on a scape, yellow, fragrant No. 3
 b. Leaves flat. 1 to 8 flowers on a scape, white No. 4
 b. Leaves flat. 4 to 12 flowers on a scape, white No. 5

1. N. Pseudo-Narcissus, L. DAFFODIL OR TRUMPET NARCISSUS. A well-known, early flower, from England and western Europe, with several narrow, flat, glaucous, erect leaves 12' to 16' high, and a straight, 2-edged scape, about equaling the leaves, bearing a single, horizontal or ascending, sulphur-yellow flower 18'' to 24'' long, with short, broad tube, spreading limb, and bell-shaped crown 1' or more in length, with the margin usually wavy-toothed or crisped. Var. *bicolor*, HORT., has the limb pure white and the crown yellow. Full, double forms, in which the crown is replaced by numerous segments, are the common daffodils. March to May.

2. N. Bulbocoddium, L. HOOP PETTICOAT DAFFODIL. A plant from the western Mediterranean region, with 1 to 4 very slender, nearly terete, channeled, green leaves, longer than the slender, terete scape 4' to 8' high, bearing a single, bright yellow flower, with the tube gradually widened from the ovary to the mouth of the crown and the segments of the ascending limb narrowed to their apex. April, May.

3. N. Jonquilla, L. JONQUIL. A common, garden flower from the western Mediterranean region, with 2 to 4 very slender, channeled, rush-like, dark green and glossy, erect leaves 8' to 12' long, and a single scape bearing 2 to 5 very fragrant, yellow flowers, with slender, cylindrical tube 10'' to 12'' long exclusive of the ovary, horizontally spreading, obovate segments of the limb 5'' to 6'' long, slightly overlapping, and a saucer-

shaped crown about 1" deep and 4" to 5" wide, the edge crenulate. April to May.

4. *N. poeticus*, L. POET'S NARCISSUS. A plant, from the same region as No. 3, with 3 or 4 *flat*, bluntly keeled, *somewhat glaucous* leaves 12' to 15' long, 5" to 6" wide, and a 2-edged scape, about equaling the leaves and bearing usually a single, fragrant flower, differing from No. 3 in being somewhat larger and in having the *tube* and *limb pure white* and the *crown yellowish*, much crisped, and *margined with red or pink*. Double-flowered varieties occur in which the crown disappears. April, May.

5. *N. tazetta*, L. POLYANTHUS NARCISSUS. The most common and most variable species of the genus, native from the Canaries to China and Japan, with 4 to 6 flattish, bluntly keeled, more or less glaucous, erect leaves 12' to 15' long, 6" or more wide, and a flattish scape about as high as the leaves, bearing an umbel of 4 to 12 fragrant, horizontal or declined flowers 15" to 18" wide, on slender pedicels, with greenish tube 9" to 10" long, white limb, the segments broad, horizontal, or slightly reflexed, and the crown bright yellow, 2" to 3" deep. Many varieties. April, May.

II. ZEPHYRÁNTHEs, HERB. Smooth herbs, with coated bulbs, linear or strap-shaped leaves, and low, erect scapes bearing a solitary, white, rose, or yellow flower in a scarious, spathe-like bract. Perianth funnel-form, erect or nearly so, with short tube, 6-parted, regular limb, spreading above, and 6 stamens with slender filaments and versatile anthers inserted in the naked throat. Style filiform, trifid. Pod 3-lobed, thin-walled, 3-celled. Seeds many, black or blackish.

About 30 species, natives of the warm regions of America.

1. *L. Atamásco*, HERB. (AMARYLLIS ATAMASCO, L.) ATAMASCO LILY. AMARYLLIS. A handsome plant, native of moist soils from Va. to Fla. and Ala. and often cultivated for ornament, with shining, bright green, fleshy, channeled leaves 6' to 12' long, and a solitary scape 6' to 12' high, bearing a white and pink, funnel-shaped flower about 3' long. Filaments and style much exceeding the tube, but not equaling the lanceolate, spreading segments. March to May.

III. GALÁNTHUS, L. SNOWDROP. Old World herbs, with coated bulbs, channeled, linear leaves, and usually a solitary, white, nodding flower from a 1-leaved spathe, at the top of a short, solid, 2-edged scape. Perianth superior, of 6 distinct, oblong divisions, the 3 outer concave, spreading, much larger than the 3 inner, erect, and notched ones. Stamens 6, epigynous, short, included; anthers erect. Style straight. Stigma entire. Capsule many-seeded.

Species variously reckoned from 8 to 8.

1. *G. nivális*, L. COMMON SNOWDROP. A small, alpine plant, native from the Pyrenees to the Caucasus, cultivated for ornament and blooming in the earliest spring, with 2 or 3 pale, linear, keeled leaves, and a scape 3' to 8' high, bearing a single, large, nodding, snow-white flower, the 3 inner segments notched and tipped with green. March to April.

IV. HYPÓXIS, L. STAR GRASS. Small, stemless herbs, with linear, grass-like, hairy leaves, and slender scapes bearing a few, small flowers, from a solid bulb or corin. Perianth superior, 6-parted, spreading, withering-persistent, the 3 outer segments somewhat herbaceous outside. Stamens 6, inserted on the base of the segments; anthers sagittate. Capsule indehiscent. Seeds many, roundish, black.

About 50 species, natives of temperate and tropical regions.

1. *H. erecta*, L. (*H. hirsuta*, Coville.) **COMMON STAR GRASS.** A pretty little plant, of dry soils in open woods and meadows throughout our area, with linear, grass-like, hairy leaves 6' to 12' long, and 2 or 3 slender, hairy scapes 3' to 6' high, each bearing 3 or 4 umbelled, star-like, yellow flowers 6'' to 9'' wide, segments oval or narrowly oblong, with a small, awl-shaped bract at the base of each pedicel. May to Aug.

2. *H. júncea*, Smith. (*H. filifolia*, Ell.) A plant, found in low, pine barrens of Ga., Fla., and westward, similar to No. 1, but with *filiform*, channelled leaves 8' to 12' long, *sparingly hairy*, and 1 or 2 yellow flowers 9'' to 12'' wide, on 1 to 3 slender scapes, downy toward the top. March, April.

ORDER 83. IRIDACEÆ — IRIS FAMILY

Perennial herbs, with rootstocks, corms, or bulbs, or tuberous or fibrous roots, erect, narrow, often 2-ranked, equitant leaves, and regular or irregular, perfect, showy flowers subtended by 2 or more spathaceous bracts. Perianth tube adherent to the 3-celled ovary; segments of limb petal-like, usually in 2 sets, convolute in bud, withering-persistent. Stamens 3, alternate with the inner perianth segments; anthers extrorse. Style 1, usually 3-cleft. Stigmas 3. Capsule 3-celled, 3-valved, loculicidal. Seeds many, with fleshy or hard albumen. Embryo straight.

More than 50 genera and about 1000 species, widely distributed.

Key to Genera

- a. Flowers regular. (b)
 - b. Outer segments of perianth larger than the inner. (c)
 - c. Stamens distinct. Style branches petaloid **IRIS** I
 - c. Stamens distinct. Style branches slender **NEMASTYLIS** *
 - c. Stamens monadelphous. Petals fiddle-shaped **TIGRIDIA** *
 - b. Outer segments of perianth similar to the inner. (d)
 - d. Stamens distinct. Tube long, partly underground **CRÖCUS** *
 - d. Stamens distinct. Tube short or none **BELAMCANDA** *
 - d. Stamens monadelphous. Flowers blue, small **SISTRINCHIUM** II
- a. Flowers irregular **GLADIOLUS** *

* See floras of Gray, Wood, Britton, etc.

I. IRIS, L. FLOWER-DE-LUCE OR FLEUR-DE-LIS. Perennial herbs, with creeping or horizontal, often tuberous rootstocks,

erect, simple or branched stems, linear or sword-shaped leaves, and large, showy flowers. Perianth tube prolonged beyond the ovary; limb 6-parted, the 3 outer segments reflexed or spreading, usually larger than the 3 inner, erect ones. Stamens distinct, the linear or oblong anthers covered by the 3 arching, petaloid branches of the style, which bear the stigmas beneath their usually 2-lobed tips. Capsule oval or oblong, 3 to 6-angled or -lobed, usually coriaceous. Seeds flattened above and below in 1 or 2 vertical rows in each cell.

More than 100 species are recognized, mostly of north temperate regions, and many of these are cultivated in numberless varieties.

Tall native species	.	.	.	.	.	.	.	.	.	No. 1, 2
Dwarf native species	.	.	.	.	.	.	.	.	.	No. 3, 4
Dwarf exotic species	.	.	.	.	.	.	.	.	.	No. 5

1. *I. versicolor*, L. **COMMON BLUE FLAG.** A plant, found in swamps and wet grounds from Canada to Fla. and Ark., with a large, horizontal rootstock, stout, leafy stem, terete or sometimes angled on one side, 2° to 3° high, often branching above, erect, sword-shaped, somewhat glaucous leaves 1° to 2° long, 6'' to 12'' wide, sheathing at the base, and terminal, single or clustered, violet-blue, purple-veined flowers, variegated with green, yellow, and white, 2' to 3' long. Outer perianth segments spatulate, 2' to 3' long, beardless and crestless; the inner erect, shorter and narrower; tube funnel-shaped, shorter than the obtusely 3-angled ovary. Style branches purple or violet, bifid at the end. Capsule oblong, with rounded angles. Seeds usually in 2 rows in each cell. April to July.

2. *I. hexágona*, WALT. **SOUTHERN BLUE FLAG.** A plant, growing in swamps and pools from N.C. to Ky. and Mo. south to Fla. and Tex., with simple, terete, leafy stem, 2° to 3° high, linear-sword-shaped, bright green, not glaucous leaves, the lower often longer than the stem, and solitary, sessile flowers, in the upper axils and terminal, similar to those of No. 1, but larger; the outer perianth segments often 4' long, and the tube longer than the ovary with its 3, deeply furrowed angles. Capsules oblong, 6-angled, whence the specific name. Seeds in 2 rows in each cell. April, May.

3. *I. verna*, L. **DWARF IRIS.** A plant, growing on wooded hillsides from southern Pa. to Ky., Ga., and Ala., with a slender rootstock, stem or scape 3' to 5' high, sheathed with colored bracts, linear, slightly glaucous, grass-like leaves longer than the stem, and a solitary violet or blue flower. Tube of the perianth filiform, 2' long, about the length of the oblong-obovate, obtuse, outer segments, which are beardless and crestless, but marked with an oblong, orange, or yellow, spotted stripe. March, April.

4. *I. cristata*, AIT. **CRESTED DWARF IRIS.** A plant, growing along streams, on hillsides, and in pine barrens from Md. to southern Ohio and Ind. south to Ga., Tenn., and Mo., with slender, creeping, tuberous-thickened rootstock, stem 3' to 5' high, bright green, lanceolate leaves 4' to 9' long, and 1 to 3 light blue flowers. Perianth tube filiform, 2' long, longer than the obovate, short-clawed segments or the spathe. Outer segments obtuse, entire, yellow, each with a triple, wavy, longitudinal crest in lieu of a beard; inner segments narrower. Ovary and capsule acutely 3-angled. April, May.

5. *I. pumila*, L. **DWARF GARDEN IRIS.** A European plant, used for borders in gardens, with a thick rootstock, stem or scape 3' to 6' high,

broad, sword-shaped leaves about as long, and a solitary, lilac-purple flower. Outer segments of perianth with a dense, white beard running down the claw. April, May.

II. SISYRINCHIUM, L. Low, tufted, slender perennials, with fibrous roots, linear, grass-like leaves, all radical or clustered at the base of the scape-like, 2-edged, or 2-winged stems, which bear 2 to 5 blue or yellow flowers in terminal umbels subtended by a pair of spathe-like bracts. Perianth deeply 6-parted, the segments equal or nearly so, spreading, oblong or obovate. Stamens inserted on the base of the perianth; filaments more or less united. Style branches or stigmas 3, thread-like, alternate with the stamens. Capsule globose to turbinate, 3-angled.

About 65 species, all American.

1. S. anceps, Cav. (S. BERMUDIANUM, L.) BLUE-EYED GRASS. An interesting little plant, common in grassy places, wet or dry, from Mass. to Fla. and La., with a 2-winged scape 6' to 12' high, either simple or forking near the top into two unequal branches subtended by a conspicuous, leaf-like bract, and 1 or 2 terminal, umbelled clusters of 2 to 5 blue, purplish, or, in some western forms white flowers with a yellow center. Bracts of spathe unequal. Perianth segments bristle-pointed. Filaments united. June, July.

2. S. angustifolium, Mill. (S. MUCRONATUM, Mx.) A plant similar to the preceding in habitat and general features, ranging from Canada to Va. and Kan., differing mainly in having the scapes *merely 2-edged, not 2-winged*, and nearly always simple, bearing but a single cluster of flowers, with very unequal bracts, colored, the outer one longer than the flowers, and the leaves very narrow and almost setaceous pointed. May to Aug.

ORDER 84. SMILACÆÆ — SMILAX FAMILY

Herbs or shrubs, with alternate, ribbed, netted-veined leaves, and small, dioecious flowers in axillary umbels. Perianth free from the ovary, regular, 6-parted, with usually 6 distinct stamens, inserted in the base of the segments. Anthers apparently 1-celled. Ovary 3-celled; 1 or 2 ovules in each cell. Stigmas mostly 8, sessile. Fruit a 3-celled, 1 to 6-seeded, globose berry. Seeds orthotropous. Embryo minute, in copious, horny albumen.

Embraces 8 genera and about 900 species of warm and temperate regions; a subfamily of *Liliaceæ*, according to some botanists.

I. SMILAX, L. Herbs or shrubs, mostly climbing by stipular tendrils, often prickly, with entire, palmately 3 to 9-ribbed,

petioled leaves, and green or yellowish, dioecious flowers in axillary, stalked umbels. Perianth of 6 similar, sepal-like, spreading, deciduous segments. Stamens in sterile flowers 6, shorter than the segments of the perianth; in fertile flowers none, or mere filaments. Ovary 3-celled, rarely 1-celled. Fruit, etc., as in the family.

About 190 species, widely distributed, mostly in tropical America and Asia. The rootstocks of several tropical American species, especially *S. officinalis*, furnish the sarsaparilla of the shops. Our species are generally known as *Greenbriers*.

1. *S. rotundifolia*, L. COMMON GREENBRIER. CAT BRIER. HORSE BRIER. A strong, woody vine, in moist thickets throughout our area, with yellowish-green, glabrous, flexuous, terete stem, 10° to 40° long, the branchlets often 4-angled, armed with stout, scattered prickles, straight or slightly curved, sometimes none, roundish-ovate, acute or acuminate, 5 to 7-veined, short-petioled leaves, round or subcordate at base, glabrous, green on both sides, 2' to 4' long, and small, greenish flowers in umbels, on flattened pedicels about as long as the petioles. Berries blue-black, glaucous, mostly 1-seeded, about 3'' in diameter. Very variable, becoming, especially in the west, Var. *quadrangularis*, GRAY, with 4-angled branches. April to June.

2. *S. lanceolata*, L. LANCE-LEAVED GREENBRIER. A stout, high-climbing vine, in rich woods and on borders of swamps from Va. to Ark. south to Fla. and Tex., with glabrous, terete, woody stem, prickly below, but mostly unarmed, thinnish, deciduous or evergreen, lanceolate to lance-ovate, acute or acuminate, 5-ribbed leaves 2' to 4' long, narrowed at base to a very short petiole, shining above, paler beneath, and many-flowered umbels on very short, terete peduncles. Berries 1 to 3-seeded, dull red until ripe, then black. Roots tuberous. June to Aug.

ORDER 85. TRILLIACEÆ — TRILLIUM FAMILY

Herbs, with tuber-like rootstocks, simple stems, whorled leaves, and perfect, terminal, solitary or few, mostly 3-parted flowers. Stamens 6 to 10. Ovary free, 3 to 5-celled. Fruit a berry.

A small family, usually included in *Liliaceæ*, consisting of 4 genera and about 80 species, belonging to temperate regions of Europe, Asia, and North America.

Key to Genera

- a. Leaves in 1 whorl. Sepals green, petals colored **TRILLIUM** I
 a. Leaves in 2 whorls. Sepals and petals alike **MEDEOLA** II

I. *TRILLIUM*, L. TRILLIUM. Small, perennial herbs, with a short rootstock, simple, naked stem terminating in a whorl of 3 large, usually broad, netted-veined leaves, and a solitary, peduncled or sessile, bractless flower blooming in spring. Perianth in 2 distinct series; the outer of 3 green, persistent,

spreading, or reflexed sepals; the inner of 3 white, pink, purplish, or sometimes greenish petals, deciduous or withering. Stamens 6, with linear, adnate, mostly introrse anthers on short filaments, the cells dehiscent on the margin. Ovary free, sessile, 3 to 6-angled, 3-celled. Stigmas 3, mostly sessile, spreading or recurved, stigmatic on the inner side. Berry ovoid or globose, 3-celled, usually 6-angled, -lobed, or -winged, many-seeded, red or purple.

More than 20 species are recognized in North America and Asia, known generally as *Wake-robin*, *Indian Shamrock*, *Three-leaved Nightshade*, or distinctively, *Trillium*

- | | |
|---|-----------|
| a. Flowers sessile, petals dark purple, erect; sepals spreading | No. 1 |
| a. Flowers sessile, petals dark purple, erect; sepals reflexed | No. 2 |
| a. Flowers peduncled, raised above the leaves. (b) | |
| b. Leaves petioled, ovate or oval, obtuse | No. 8 |
| b. Leaves petioled, ovate, acuminate | No. 4 |
| b. Leaves sessile, rhomboidal, nearly as broad as long | Nos. 5, 6 |
| a. Flowers peduncled, deflexed beneath the leaves | No. 7 |

1. *T. sessile*, L. **SESSILE-FLOWERED TRILLIUM.** A small plant, in moist woods from Pa. to Minn. south to Fla., Miss., and Ark., with a slender stem, 6' to 12' high, rhombic-ovate, acute, *sessile*, often purplish-spotted or -blotched leaves 2' to 3' long, a sessile flower, ovate-lanceolate or lanceolate, acute, *erect or spreading sepals* 8" to 12" long, and *erect to spreading, sessile, lanceolate*, dark or dull purple or greenish *petals* longer than the sepals. *Connective of the anthers broad and produced beyond the cells.* Fruit globose, 6-angled, about 6" long. April, May.

2. *T. recurvatum*, BECK. **PRAIRIE TRILLIUM.** A small plant, allied to No. 1, in rich, shady woods and thickets from Ohio and Ind. to Minn. south to Miss. and La., with rather thick stem, 8' to 10' high, ovate, oval, or obovate, acute leaves 2' to 4' long, narrowed to the base, and a *distinct petiole*, a sessile flower, lanceolate, acuminate, *reflexed sepals* about 1' long, and *erect, oblong-lanceolate, clawed*, dark purple *petals* about as long as the sepals. *Connective of the anther cells as in No. 1.* Fruit ovoid, 6-winged, about 9" long. April, May.

3. *T. nivale*, RIDDELL. **SNOWY OR DWARF WHITE TRILLIUM.** A very small plant, in rich woods or in dry fields from western Pa. to Wis., Iowa, Minn., and Ky., with stem 2' to 4' high, oval or ovate, obtuse, distinctly and abruptly petioled leaves 1' to 2' long, an erect or inclined peduncle 6" to 12" long, oblong or oval, obtuse, white petals about as long as the peduncle and longer than the erect to spreading sepals. *Connective not produced beyond the anther cells: this feature belongs also to all the succeeding species.* Berry depressed-globose, 3-lobed, 6" in diameter. April.

4. *T. erythrocarpum*, Mx. (*T. pictum*, Ph.) **PAINTED TRILLIUM. SMILING WAKE-ROBIN.** A handsome plant, in cold or damp woods from Me. to Wis. south to Ga. and Mo., with a slender stem, 8' to 16' high, broadly ovate, long-acuminate, petioled leaves 3' to 6' long, an erect or nearly erect peduncle 1' to 2' long, lanceolate, acuminate sepals 9" to 15" long, and ovate or ovate-lanceolate, acute, widely spreading, wavy-edged, white petals, much longer than the sepals and painted with purple lines at the base. Berry broadly ovoid, obtuse, and obtusely 3-lobed, 7" to 9" long, bright red, shining. May.

5. *T. grandiflorum*, SALISB. **LARGE-FLOWERED TRILLIUM.** A handsome plant, in rich woods from Vt. to Minn. south to N.C. and Mo., with usually a stout stem, 8' to 18' high, broadly rhomboid-ovate, subsessile, abruptly acuminate leaves 2' to 6' long, an erect or inclined peduncle

2' to 3' long, lanceolate, acute, spreading sepals 1' to 2' long, and erect to spreading, broadly oblanceolate or obovate, white varying to pink petals 18'' to 30'' long. Berry globose, somewhat 6-lobed, 6'' to 12'' long, black when mature. May.

6. *T. erectum*, L. ILL-SCENTED TRILLIUM. BATH FLOWER. A conspicuous plant, in woods from Me. to Minn. south to N.C., Tenn., and Mo., with a stout stem, 10' to 14' high, rhomboidal, short-acuminate, sessile leaves 3' to 5' long, an erect, inclined, or declinate peduncle 1' to 3' long, lanceolate, acuminate, spreading sepals 6'' to 18'' long, and ovate, acute, dusky purple, pinkish, green, or often white petals about as long as the sepals. Stamens as long as or longer than the spreading, recurved stigmas. Berry ovoid, slightly 6-lobed, 10'' to 12'' long, reddish. April, May.

7. *T. cernuum*, L. NODDING OR DROOPING TRILLIUM. A plant, found in damp and rich woods from Me. to Minn. south to Ga. and Mo., with tall, slender stem, 12' to 20' high, leaves somewhat similar to those of No. 6, but *petioled*, and 3' to 6' long, the *peduncle, decurved beneath the leaves*, as long as the pendent flower, the sepals lanceolate, 6'' to 12'' long, recurved, and the petals ovate-lanceolate, wavy, recurved to spreading, white or pink, and about as long as the sepals. Berry ovoid, 8'' to 10'' long, reddish-purple, drooping. April to June.

II. *MEDËOLA*, L. INDIAN CUCUMBER ROOT. A perennial herb, with a slender, erect, simple stem, 1° to 2° high, clothed when young with loose, deciduous, cottony wool, and in the flowering plants bearing 2 whorls of parallel-ribbed, netted-veined, entire leaves; those of the lower whorl, above the middle of the stem, 5 to 9, obovate-lanceolate, acuminate, sessile, and 3' to 4' long; those of the other, at the top, usually 3, much smaller, ovate, and involucrate to a sessile umbel of 2 to 5, small, greenish-yellow flowers on curving pedicels. The flowerless plants, 6' to 10' high, terminate in the single, larger whorl. The horizontal, clean, white, fleshy, crisp root-stock 1' to 2' long, with numerous fibrous roots, has a decided cucumber-like flavor. Perianth of 6 similar, oblong, petaloid, recurved segments. Stamens 6 with slender filaments. Styles 3, long, thread-like, diverging, recurved, reddish-brown, stigmatic on the upper side. Berries globose, dark purple, 3-celled, 3 to 6-seeded, on erect pedicels. A monotypic genus of eastern North America.

1. *M. Virginiana*, L. A handsome, symmetrical plant, common in rich, moist woods from Me. to Minn. south to Fla. and Tenn. June.

ORDER 86. LILIACEÆ — LILY FAMILY

Herbs, with simple scapes or leafy stems, from bulbous, rhizomatous, or fibrous roots, parallel-veined or ribbed leaves, and regular, mostly perfect flowers. Perianth free

from the ovary, of 6, rarely 4, similarly and mostly highly colored, distinct, nearly distinct, or sometimes united segments, with as many stamens at their bases or hypogynous. Anthers mostly introrse. Styles wholly, or rarely partly, united. Stigmas 3-lobed or capitate. Ovary superior, 3-celled, rarely 2-celled. Fruit a loculicidal capsule or a berry. Seeds few or many, with fleshy albumen.

About 140 genera and more than 1500 species, widely distributed.

Key to Genera

- § I. *Plants with style entire, fruit a capsule and root bulbous.* (a)
- a. Stem scape-like, 1-flowered. (b)
 - a. Stem leafy above as well as below. (c)
 - a. Stem scape-like, many-flowered. (d)
 - b. Flowers nodding, with 2 sheathing leaves . . . **ERYTHRONIUM** I
 - b. Flowers erect, with 2 or more sheathing leaves . . . **TULIPA** II
 - c. Perianth segments with a linear groove at the base . . . **LILIUM** III
 - c. Perianth segments with a roundish cavity at the base . . . **FRITILLARIA** IV
 - d. Perianth segments distinct, not forming a tube. (e)
 - d. Perianth segments united, forming a tube. (f)
 - e. Flowers blue, in a simple raceme . . . **CAMASSIA** V
 - e. Flowers white or yellow, in a corymb . . . **ORNITHOGALUM** VI
 - e. Flowers in an umbel . . . **ALLIUM** *
 - f. Perianth limb revolute, as long as the tube . . . **HYACINTHUS** VII
 - f. Perianth limb spreading or erect, much shorter than the tube . . . **MUSCARI** VIII
- § II. *Plants with style and fruit as in § I, and root a rhizome, or the stem caudex.* (g)
- g. Perianth segments distinct. Flowers panicled. Stem a caudex . . . **YUCCA** IX
 - g. Perianth segments more or less united into a tube. (h)
 - h. Flowers white to blue. Leaves broad . . . **FUNKIA** X
 - h. Flowers yellow. Leaves narrow . . . **HEMEROCALLIS** XI
- § III. *Plants with style entire, fruit a berry, and the root a rhizome or fibrous.* (i)
- i. Perianth segments united. Flowers greenish, axillary . . . **POLYGONATUM** XII
 - i. Perianth segments united. Flowers white, on a scape . . . **CONVALLARIA** XIII
 - i. Perianth segments separate. (k)
 - k. Stemless. Scape bearing an umbel. Berries blue . . . **CLINTONIA** *
 - k. Stem leafy, bearing a terminal, leafless, white cluster. (l)
 - k. Stem leafy, bearing the flowers solitary or in pairs. (m)
 - l. Flowers 6-parted . . . **SMILACINA** XIV
 - l. Flowers 4-parted . . . **MAIANthemum** XV
 - m. Stems much branched, with filiform leaves . . . **ASPARGUS** *
 - m. Stems forking, with oval leaves. (n)
 - n. Flowers axillary. Berry many-seeded . . . **STRÉPTOPUS** *
 - n. Flowers terminal. Berry 8 to 6-seeded . . . **PROSARTES** *
- § IV. *Plants with style 3-cleft or 3-parted. Fruit a capsule.* (o)
- o. Leaves perfoliate. Pod truncate, 8-lobed . . . **UVULARIA** XVI
 - o. Leaves sessile. Pod acutish at each end, 8-winged . . . **OAKESIA** XVII

* See fuller floras of Gray, Wood, Britton, etc.

I. ERYTHRONIUM, L. Low herbs, with a deep corm, a slender, scape-like, simple stem, bearing 2 shining, unequal leaves tapering into petioles, which sheathe it near the ground as if radical, or in flowerless plants only one, and large, nodding terminal flowers, solitary in our species, several in some

western ones. Perianth bell-shaped, with 6 distinct, recurved, lanceolate or oblanceolate, deciduous segments, the 3 inner ones usually with a short tooth on each side of the erect base and a groove in the middle. Stamens 6, shorter than the segments. Anthers oblong-linear, erect. Style filiform, thickened at the top, 3-lobed or 3-cleft. Capsule obovoid, 3-celled. Seeds several or many.

About 18 species are known, 4 of the Old World, including the Asiatic and European, *E. Dens-Cants*, the true *Dog's-tooth Violet*, 4 of eastern North America, and the rest of the Rocky Mountains and of northwestern North America.

1. *E. Americānum*, KER. YELLOW ERYTHRONIUM OR ADDER'S TONGUE. A common, perennial herb, often growing in patches, especially the flowerless, 1-leaved ones, in moist, rich woods and thickets from Me. to Minn. south to Fla. and Ark., with a pair of elliptic-lanceolate, *acute*, pale green, *mottled leaves* 4' to 6' long, one much wider than the other, and a slender scape 4' to 6' high, bearing a single, nodding, *yellow flower*, the recurved, spreading segments about 1' long, and the 3 inner ones 2-toothed at the base. *Style club-shaped; stigma obscurely 3-lobed*. The ovoid corm is often 6' beneath the surface. March to May.

2. *E. albidum*, NUTT. WHITE ERYTHRONIUM OR ADDER'S TONGUE. A similar plant to No. 1, of like habitat and ranging from N.Y. and N.J. to Minn. and Mo. south to Ga., Tenn., and Tex., with the *leaves obtuse and less or not at all mottled*, the perianth segments white, pinkish, or sometimes purplish, the 3 inner ones *toothless at base*, and the *style slender, with 3 distinct, spreading stigmas*. March to May.

II. *TULIPA*, TOURN. TULIP. Ornamental, Old World herbs, with coated bulbs, simple stems, 2-leaved or few-leaved at or near the base, naked above, usually 1-flowered, rarely 2 to 4, at the top. Perianth bell-shaped, mostly erect, deciduous, with 6 distinct segments destitute of nectaries, often spotted inside near the base. Stamens 6, hypogynous, shorter than the perianth; anthers erect. Stigma sessile or nearly so. Capsule 3-celled. Seeds many, flat.

More than 80 species are recognized, about half of them in ornamental cultivation.

1. *T. Gesneriāna*, L. COMMON TULIP. The assumed original of the most common garden forms, with erect stem, 6' to 24' high, 3 to 6 lanceolate or ovate-lanceolate, glaucous, usually wavy leaves, and a solitary, terminal, erect, bell-shaped, scentless, red flower, 24'' to 30'' long, the segments broadly rounded at the apex and obscurely blotched at the base. The varieties in color, marking, etc., are endless, more than 700, according to Wood's *Class Book of Botany*, having been described more than 40 years ago in florists' catalogues. The native country is uncertain, Persia and Asia Minor being named by some authorities. It was introduced from Turkish gardens in 1554. May, June.

III. *LILIUM*, L. LILY. Herbs, with mostly scaly bulbs, tall, erect, simple stems, rarely branched at the top, alternate, scattered or whorled, sessile, usually narrow leaves, and one or

several, large, handsome, erect, nodding or drooping flowers. Perianth funnel-shaped or bell-shaped, colored, deciduous, of 6 distinct segments, each bearing a longitudinal honey groove at the erect base and spreading or curving outward toward the top. Stamens 6, shorter than the style, hypogynous or adhering slightly to the segments. Anthers linear, versatile, the cells opening lengthwise. Style long, somewhat club-shaped; stigma 3-lobed. Capsule oblong or obovoid, subtriangular, 3-celled. Seeds many, flattened above and beneath, packed in 2 rows in each cell.

About 45 species are known, confined to north temperate regions and the mountains of subtropical Asia.

- | | |
|---|--------------|
| a. Flowers orange, red, or yellow. Native species. (b) | |
| b. Flowers erect | Nos. 1, 2 |
| b. Flowers nodding | Nos. 3, 4, 5 |
| a. Flowers orange or red, with bulblets in upper leaf axils. Cultivated | Nos. 6, 7 |
| a. Flowers white. Cultivated | Nos. 8, 9 |

1. *L. Philadelphicum*, L. PHILADELPHIA, WOOD, OR WILD ORANGERED LILY. A showy plant, in dry woods and fields from New Eng. to Minn. south to N.C. and Mo., with a bulb, 1' in diameter, of a few, thick, fleshy, jointed scales, a smooth, terete, simple stem, 15' to 30' high, nearly naked below, linear-lanceolate, acute, 1-veined, scattered, and whorled leaves 2' to 3' long, and usually 1, erect, terminal, open, bell-shaped flower or sometimes an umbel of 2 to 4. Segments lance-ovate, obtuse or acutish, 2' to 3' long, on distinct, erect to spreading claws 6'' long, orange-red, with darker spots toward the center. Lower leaves usually scattered, upper ones in 1 to 3 whorls of 3 to 5. Capsule obovoid, 1' to 2' high. Seeds narrowly winged. June, July.

2. *L. Catesbæi*, WALT. CATESBY'S LILY. A somewhat similar plant to No. 1, in low or damp pine barrens from Md. (?) or N.C. to Ky. and Mo. south to Fla. and Ala., with thin, narrow, bulb scales bearing narrowly linear often caducous leaves 2' to 4' long, a simple stem 18' to 30' high, linear-lanceolate, erect, scattered leaves 1' to 2' long, and a single, terminal, open-bell-shaped, scarlet flower, variegated with yellow and purple, the segments ovate-lanceolate, wavy-margined, on slender claws 1' long, and tapering to a long, reflexed acumination. Capsule oblong. July, Aug.

3. *L. superbum*, L. AMERICAN TURK'S-CAP LILY. A stately and handsome plant, common in meadows, marshes, and rich, low grounds from Me. to Minn. south to Ga. and Mo., with a globose bulb, 1' to 2' in diameter, of thick, ovate, white scales, and sending out scaly rhizomes, an erect stem, 4° to 6° high, lanceolate or linear-lanceolate, acuminate, 3-nerved, smooth leaves 2' to 3' long, the lower in whorls of 3 to 8, the upper scattered, and 3 to 20 or more, long-peduncled, nodding, bright orange, orange-yellow, or rarely red, purple-spotted flowers with revolute segments, the flowers when numerous forming a large pyramidal raceme. Segments of perianth sessile, linear-lanceolate, 2' to 4' long, and strongly revolute. July, Aug.

4. *L. Carolinianum*, Mx. CAROLINA LILY. A plant, of strangely various habitat, in dry woods or in swamps, from Va. to Fla. and La., similar to No. 3, with rhizomatous, scaly bulb, but with stem 2° to 3° high, the leaves 1-nerved, oblanceolate or obovate, short-acuminate, tapering to a slender base, in whorls of about 5 above, or often all scattered,

and usually a solitary, long-peduncled, nodding, deep yellow, purple-spotted flower, the segments 3' to 4' long, sessile, *strongly recurved but not revolute*. Flowers sometimes 2 or 3. July, Aug.

5. *L. Canadense*, L. WILD YELLOW LILY. A handsome plant, growing in swamps and moist meadows and fields from Me. to Minn. south to Ga., Ala., and Mo., with a bulb similar to that of No. 3, a stem 2° to 4° high, lanceolate or oblanceolate, acuminate, 3-nerved leaves 2' to 4' long, mostly in remote whorls of 4 to 6, rough on the margin and rough or hairy on the nerves beneath, often a few scattered ones below, and 1 to 3, sometimes 7 to 20, terminal, long-peduncled, nodding, yellow or orange, usually purple-spotted flowers, with sessile, spreading and recurved, but not revolute segments. June, July.

6. *L. tigrinum*, KER. TIGER-SPOTTED LILY. A plant from China and Japan, common in gardens and somewhat escaped in Me. and Mass., with a globose, solitary, scaly, perennial bulb, a stout, purple or blackish stem, 2° to 6° high, whitish-pubescent or cobwebby above, dark, glossy green, 5 to 7-nerved, scattered, lanceolate leaves 4' to 6' long, or the shorter, upper ones cordate-ovate and bearing *bulblets in their axils*, and a wide raceme of 5 to 20 or more nodding, dark orange, purplish-spotted flowers with *revolute and twisted segments*. July, Aug.

7. *L. bulbiferum*, L. ORANGE LILY. A European plant, common in old gardens, with an ovoid bulb, a rigid, erect, furrowed stem, 2° to 4° high, very numerous, lanceolate-linear, irregularly scattered leaves, the upper ones bearing solitary or clustered, stalked or sessile, *chestnut-brown bulblets in their axils*, and a few, several or many, short-pediceled, erect, reddish-orange flowers in a terminal raceme sometimes shortened into an umbel. Perianth segments erect to spreading, sessile, 24" to 30" long, papillose inside at base. July.

8. *L. candidum*, L. COMMON WHITE LILY. MADONNA LILY. ST. JOSEPH'S LILY. A well-known garden flower from the Levant, with a large, ovoid bulb, a stiff, erect stem, 2° to 4° high, and very numerous, scattered, erect to spreading, lanceolate-linear, acute leaves, the lowest 6' to 8' long, 6" to 12" wide above the middle, upper ones bract-like, and a terminal raceme of 6 to 25 bell-shaped, fragrant, pure, pearl-white flowers 2' to 3' long, rarely purplish-tinged outside. Several varieties in cultivation. June, July.

9. *L. longiflorum*, THUN. LONG-FLOWERED WHITE LILY. A very handsome plant from China and Japan, with a globose bulb, a stem 1° to 3° high, scattered, linear to lanceolate, 5-nerved, shining, green leaves 3' to 5' long, and usually but one nearly horizontal, narrow-funnel-form, fragrant, white, waxlike flower 5' to 7' long. Flowers sometimes 2 or 3 or more. Var. *eximium*, NICHOLSON (*L. Harrisii*, CARR. and the florists), with more and larger flowers, is the common *Easter Lily*, called also *Harris's Lily*, and, from the place of its principal cultivation for market, *Bermuda Lily*.

IV. FRITILLARIA, L. FRITILLARY OR CHECKERED LILY.

Herbs, with coated or scaly bulbs, erect stems, alternate or somewhat whorled, often glaucous leaves, and terminal or axillary, solitary, racemed or rarely umbelled, nodding, bell-shaped flowers. Perianth of 6 distinct, oblong or ovate, deciduous segments often spotted, each with a honey pore near its base. Stamens 6, hypogynous; filaments thread-shaped or slightly flattened; anthers fixed by the base.

Ovary 3-celled; style long; stigma 3-lobed or 3-cleft. Capsule many-seeded.

More than 50 species, natives of southern Europe, Asia, and western North America.

1. *F. Meleagris*, L. COMMON FRITILLARY OR CHECKERED LILY. GUINEA-HEN FLOWER. An ornamental plant, native from England to Caucasus, with a coated bulb, a simple stem, 1° high, long, alternate, very narrow, linear, channeled leaves, and normally a large, solitary, nodding, terminal flower, beautifully checkered with various shades of purple, red, or yellow, according to the variety. The specific name is the Latin for Guinea hen. May.

2. *F. Imperialis*, L. (*IMPERIALIS CORONATA*, DUM.) CROWN IMPERIAL. A stately plant, of old-fashioned, country gardens, from Persia, with a scaly bulb, an erect, simple, stout, striate stem, 3° to 4° high, thickly clothed below with long, narrow, entire, more or less whorled, bright green leaves, naked above, and bearing at the top several large, red, or yellow flowers, resembling tulips in shape and size, but drooping in a crown-like umbel, which is itself still further crowned by a tuft of narrow leaves, a pair from the base of each pedicel. Several varieties in cultivation. For 300 years this was supposed to be the only species with umbelled flowers, but in 1897 another one, *F. Raddeana*, was announced in a horticultural journal. May.

V. *CAMASSIA*, L. CAMASS. Stemless, North American herbs, with edible, membranous-coated bulbs, linear leaves, and a scape bearing a simple, terminal raceme of blue, purple, or whitish flowers on jointed, mostly bracted pedicels. Perianth of 6 distinct, spreading, 3 to 7-nerved segments, bearing on their bases the 6 slender filaments with oblong, versatile anthers. Stigma 3-lobed; style thread-like, its base persistent on the ovary. Capsule obovoid or oval, 3-angled, 3-celled, with several roundish, shining, black seeds in each cell.

About 5 species, 4 of them west of the Rocky Mountains.

1. *C. Fraseri*, Torr. (*QUAMASIA HYACINTHINA*, BRITTON.) FRASER'S OR EASTERN CAMASS. WILD HYACINTH. A plant, found in wet meadows and prairies and along streams from Pa. and Md. to Minn. and Kan. south to the mts. of Ga. and Ala., with an ovoid, onion-like bulb, 12'' to 18'' long, usually nearly black in its outer coat, linear, keeled, flaccid, recurved leaves, tapering at each end, 2'' to 4'' wide, and shorter than the scape, which is 12' to 18' high, and pale blue flowers on filiform pedicels, about as long as the subtending, solitary, subulate, scarious bracts, or the linear-lanceolate, 3 to 5-nerved sepals 4'' to 7'' long. The simple, open raceme, 2' to 4' long, elongates in fruit. Capsule globose, acutely triangular. April, May.

VI. *ORNITHOGALUM*, L. Stemless, Old World herbs, with coated bulbs, narrow, fleshy, radical leaves, and white or yellow flowers in bracted racemes or corymbs on a scape. Perianth segments 6, nearly or entirely distinct, 5 to 7-nerved, usually spreading. Stamens 6, hypogynous; filaments more or less

flattened. Ovary free, 3-celled; style short or long; stigma 3-lobed or capitate. Capsule membranous, 3-celled. Seeds few or many, globose, black, shining.

More than 100 species, natives of Europe, Asia, and Africa.

1. *O. umbellatum*, L. **STAR OF BETHLEHEM.** A small, European, tufted plant, escaped from cultivation and naturalized in lawns, fields, and meadows from Mass. to Pa., Va., and southward, with ovoid, membranous-coated bulb, narrow, linear, channeled, dark green leaves 4' to 9' long, the midvein a lighter color, and a slender scape 4' to 8' high, bearing a loose corymb of 5 to 8 white flowers, on spreading, bracted pedicels. Perianth segments oblong-lanceolate, 5'' to 8'' long, striped lengthwise with green on the outside. Stamens about half as long as the sepals. May, June.

VII. HYACINTHUS, L. HYACINTH. Stemless, Old World herbs, with coated bulbs, linear or strap-shaped, radical leaves, and showy flowers in terminal racemes or spikes on a naked scape. Perianth funnel-shaped or bell-shaped, 6-cleft, the spreading, recurved lobes about as long as the tube. Stamens 6, adherent to the tube, free at the apex. Ovary superior, globose, crowned by the short, erect style and 3-cornered stigma. Seeds few.

About 80 species, mostly of the Mediterranean region and the Orient.

1. *H. orientalis*, L. **COMMON OR DUTCH HYACINTH.** A well-known, ornamental herb from the Levant, with 4 to 8 thick, green, linear-lanceolate, grooved leaves 4' to 8' long, and a stout scape 8' to 12' high, bearing a raceme of blue flowers, often double, with the tube swollen by the ovary within. Stamens included. Varieties of all shades of white, pink, red, yellow, etc., nearly all double, occur. Var. *albulus*, BAKER, a smaller and slenderer form from southern France, with narrower, very erect leaves, fewer and earlier, white or pink flowers, the tube not swollen below, and the lobes narrower and shorter, is the parent of the so-called *Roman hyacinths* as the type represents the *Dutch*. April, May.

VIII. MUSCARI, TOURN. GRAPE HYACINTH. Old World herbs, with coated bulbs, linear, radical leaves, and small, blue or white, drooping or nodding, bracted flowers in a terminal raceme on a scape. Perianth tardily deciduous, globular, urn-shaped, ovoid, or oblong, with constricted throat and a limb of 6 short, spreading or reflexed teeth or lobes. Otherwise much as in *Hyacinthus*.

About 40 species, all of the Mediterranean region.

1. *M. botryoides*, L. **COMMON GRAPE HYACINTH.** A pretty little plant, common in country gardens and somewhat naturalized by escape in lawns and fields and by roadsides from Mass. to Ohio and Va., with erect, linear, channeled leaves 2'' to 4'' wide, and about as long as the erect scape, 4' to 10' high, which bears an oblong-cylindric raceme of glo-

bose, deep blue, inodorous flowers, with recurved white teeth, resembling minute grapes. Varies with flowers pale blue, roseate, or white. April to June.

2. *M. racemòsum*, L. A plant similar to the preceding, but with broader leaves, the flowers oblong-ovoid, fragrant, and blooming nearly a month earlier. April, May.

IX. YÚCCA, L. YUCCA. Evergreen, American plants, with woody, palm-like stems, either very short, sometimes subterranean, or rising into a leafy or naked, and rarely an arborescent trunk, rigid, linear or sword-shaped, sharp-pointed, persistent leaves, and large, bracted, nodding flowers in a terminal panicle or raceme. Perianth of 6 petal-like, white or whitish, oval or oblong, acute segments, longer than the 6 stamens; the 3 inner broader. Stigmas 3, sessile. Ovary free. Capsule oblong, obtusely 6-angled, 3-valved at the top, 3-celled or imperfectly 6-celled by a false partition. Seeds many, 2-rowed in each cell.

About 15 species, natives of dry and arid regions of U.S., Mexico, and adjacent regions.

1. *Y. filamentòsa*, L. **THREADY YUCCA. ADAM'S NEEDLE. BEAR GRASS.** A nearly stemless, hardy, ornamental plant, native in light and sandy soils from Md. to Fla. and La., especially near the coast, with numerous, linear-lanceolate, rigidly acute, coriaceous leaves 1° to 2° long, 12" to 18" wide, spreading and erect, densely clustered at the top of the short stem, which scarcely rises out of the ground or only a few inches above it, and a stout, bracted scape 3° to 6° high, bearing a large, pyramidal panicle of drooping, cup-shaped, cream-white flowers. Perianth segments 18" to 24" long. Leaves margined with long, *thread-like* or *filamentous fibers*, whence the botanical specific name. May to July.

X. FÚNKIA, SPRENG. PLANTAIN LILY. WHITE OR BLUE DAY LILY. Stemless herbs from eastern Asia and Japan, with fascicled, tuberous roots, ovate, oblong, or lanceolate, ribbed, petioled, radical leaves, netted-veined between the ribs, and ephemeral, white or blue, bracted flowers in a terminal raceme or spike on a scape. Perianth tubular-funnel-form, 6-cleft; lobes somewhat irregular, scarcely spreading. Stamens 6, hypogynous; filaments filiform; anthers versatile. Capsule oblong, 3-angled, 3-valved. Seeds many, 2-rowed, black, flat, winged at the end.

The 5 or 6 species, all from Japan and China, are in much confusion from the many garden varieties and synonyms.

1. *F. subcordàta*, SPRENG. (*F. ALBA*, SWEET.) **WHITE PLANTAIN LILY.** A Japanese plant, very common in cultivation, with pale green, many-ribbed, cordate-ovate, abruptly acuminate leaves 6' to 9' long, on petioles 6' to 8' long, forming clumps of foliage 12' to 20' high, and a few ascending, open-bell-shaped, waxy white, fragrant flowers 4' to 6' long,

each subtended by a conspicuous broad bract with a smaller one inside, in a short, terminal raceme on an ascending or erect scape 18' to 24' long. Aug. to Sept.

2. *F. Sieboldiana*, HOOK. (*F. SINENSIS*, SIEBOLD.) SIEBOLD'S OR GLAUCCUS PLANTAIN LILY. A Chinese plant, differing from No. 1 in having *glaucous, bluish*, less cordate leaves 10' to 12' long by 7' to 8' wide on petioles 8' to 12' long, and smaller and more slender-tubed, pale lilac flowers with but one bract at the base of each pedicel, in a raceme not rising above the leaves. Summer.

3. *F. ovata*, SPRENG. (*F. CÆRULEA*, SWEET.) BLUE PLANTAIN LILY. A plant from northern China, Siberia, and Japan, common in cultivation, with green, broad-ovate leaves 5' to 9' long, tapering to a petiole, or sometimes subcordate, on petioles 4' to 12' long, and a long raceme of blue, lilac, or sometimes white, nodding flowers about 2' long, *having a slender tube and a suddenly dilated, bell-shaped limb*. Summer.

4. *F. lancifolia*, SPRENG. (*F. ALBO-MARGINATA*, HOOK.) WHITE-MARGINED PLANTAIN LILY. A Japanese plant, similar to No. 3, but with lanceolate leaves 4' to 6' long, narrowed to both ends, margined with white, on petioles 6' to 9' long, and lilac flowers. Summer.

XI. HEMEROCALLIS, L. YELLOW DAY LILY. Old World perennials, with fascicled, tuberous roots, long, linear, radical leaves, and showy, yellow or orange, corymbed flowers on a scape. Perianth funnel-form, lasting but one day, whence the generic name, signifying *beauty for a day*; tube cylindrical, short, inclosing the free ovary; limb 6-parted, lobes oblong or oblanceolate, spreading. Stamens 6, inserted in the throat of the tube; filaments slender, shorter than the lobes, curved upward like the slender but longer style. Stigma entire. Capsule oblong, 3-celled, etc., as in the family.

About 7 species, natives of Europe and Asia, and all in cultivation.

1. *H. fulva*, L. ORANGE DAY LILY. A common, border perennial, native from southern Europe to Japan, common in country gardens and extensively escaped in meadows and along streams from Me. to Ohio south to Va. and Tenn., with very numerous, linear, grass-like, channeled leaves 1° to 3° long, 9'' to 15'' wide, tapering to an acute point, and 6-12 tawny-red (*fulva*) or orange, short-pedicel flowers 4' to 5' long in a corymb-like panicle on a stout, terete, smooth, naked scape, bracted and branching at the top, 3° to 4° high. *Petals obtuse, wavy; sepals acutish, the veins branched*. July, Aug.

2. *H. flava*, L. YELLOW OR LEMON DAY LILY. A plant, common in cultivation and sparingly escaped, of the same native range as No. 1, and with leaves and scape nearly the same, but with the *flowers bright or lemon-yellow (flava), smaller and fragrant, the segments of the perianth all flat and acute and the veins of the sepals undivided*. June, July.

XII. POLYGONATUM, TOURN. SOLOMON'S SEAL. Smooth or pubescent, perennial herbs, with a thick, horizontal, *jointed rootstock*, whence the generic name, meaning *many-jointed*, marked with circular, depressed, seal-like scars by the falling away of the stems of previous years, whence the vernacular

name, and a simple, erect or curving, arched stem, naked below, leafy above, the ovate or lanceolate leaves alternate, nerved, more or less sessile in our species, opposite or whorled in some foreign ones, and drooping, axillary, solitary, or umbelled, greenish, pinkish, or white flowers. Perianth tubular, somewhat inflated below; limb of 6 short, erect lobes. Stamens 6, inserted near or above the middle of the tube, included; anthers sagittate, introrse. Ovary free, 3-celled. Style slender, included. Berry globular, 3 to 6-seeded, blue or black.

About 23 species, widely distributed in temperate regions.

1. *P. biflorum*, ELL. TWO-FLOWERED OR HAIRY SOLOMON'S SEAL. A plant, common in woods, thickets, and on shady hillsides from Me. to Minn. south to Fla. and Tex., with smooth, slender stem, arching, often zigzag above, 1° to 3° high, alternate, 2-ranked, lanceolate, oval or oblong, acute or acuminate, several-nerved leaves 2' to 4' long, smooth above, but *more or less pubescent or hairy beneath*, and nodding or pendulous, axillary, solitary peduncles, each supporting 1 to 3, *mostly 2*, greenish-yellow flowers 4'' to 6'' long, or in fruit as many blue-black berries 3'' to 4'' in diameter. *Filaments granular-roughened*. April to June.

2. *P. giganteum*, DIETRICH. GREAT OR SMOOTH SOLOMON'S SEAL. A taller and more robust plant than No. 1, found in rich alluvium, moist woods, and along streams from New Eng. to Minn. south to Ga. and La., with a smooth, stout, terete stem, naked below and leafy and arching above, 2° to 5° high, half clasping or sessile, lanceolate, oval or ovate, many-nerved leaves 3' to 8' long, glabrous on both sides, and 2 to 8-flowered, drooping or nodding peduncles. Perianth 5'' to 9'' long. *Filaments smooth*. Berries 4'' to 6'' in diameter. May to July.

XIII. CONVALLARIA, L. A low, stemless, perennial herb, with slender rootstock, numerous fibrous roots, 2, rarely 3, oblong, acute, erect leaves on sheathing petioles, one petiole enveloped by the other, and the two encircled at base by sheathing scales, and a simple, smooth, angled scape bearing a 1-sided raceme of dainty, white, fragrant flowers drooping on slender pedicels from the axils of lanceolate bracts. Perianth deciduous, globose-bell-shaped, with 6 short, recurved lobes. Stamens 6, included; anthers introrse. Ovary 3-celled, tapering to a thick style; cells 4 to 6-ovuled. Berry few-seeded.

A monotypic genus of temperate Europe and Asia and the higher Alleghanies.

1. *C. majalis*, L. LILY OF THE VALLEY. A widely and extensively cultivated plant, native in the higher mountain woods from Va. to Ga., as well as in the Old World, with usually 2 erect, ovate-ellipsoidal leaves 5' to 8' long, tapering at both ends, a scape 6' to 8' high, and flowers 3'' to 4'' long or wide, on pedicels 2 to 3 times their length. May.

XIV. SMILACINA, DESF. FALSE SOLOMON'S SEAL. Perennial herbs, with slender, creeping, or short, thick rootstocks,

simple stems, scaly below, leafy above, alternate, nerved, usually sessile, ovate, lanceolate, or oblong leaves, and terminal, simple or compound raceme, of small, white or greenish-white flowers. Perianth 6-parted, spreading. Stamens 6, inserted at the base of the segments; filaments slender; anthers ovate, introrse. Ovary globose, 3-celled; cells 2-ovuled; style short, thick. Berry globose, pulpy, 1 to 3-seeded.

About 25 species, natives of North and Central America, and temperate and mountainous Asia.

1. *S. racemosa*, DESF. FALSE SPIKENARD. CLUSTERED SOLOMON'S SEAL. A minutely downy plant, common in moist woods and copests from Me. to the Dakotas, south to Ga., eastern Kan., and Ark., with rather thick, fleshy, creeping, sweetish rootstock, erect or ascending stem, 18' to 24' high, recurving above, 2-ranked, oval or oblong-lanceolate, acuminate, sessile or subsessile, ciliate leaves 4' to 6' long, and a terminal, peduncled, compound raceme of greenish-white flowers about 2" wide, on very short pedicels, with exserted stamens, succeeded by subpellucid, pale red, speckled, aromatic berries about as large as small peas. April to June.

XV. MAIÁNTHENUM, WIGG. Low, perennial herbs, with a slender rootstock, erect, simple stem, 1 to 3 petioled or sessile leaves, and a short, terminal, simple raceme of small, white flowers. Perianth 4-parted. Stamens 4. Ovary 2-celled. Otherwise, as in *Smilacina*, under which they are placed by some botanists.

Only 2 species are recognized, the one below of eastern North America, the other of northwestern America and the Old World.

1. *M. Canadense*, DESF. (*SMILACINA BIFOLIA*, Var. *Canadensis*, GRAY.) TWO-LEAVED SOLOMON'S SEAL. A pretty, little, glabrous or pubescent plant, common in moist woodlands from Me. to Minn. south to N.C., with a slender, angular, erect, often zigzag stem, 4' to 6' high, usually 2, rarely 1 or 3, ovate to lanceolate, finely nerved leaves 1' to 3' long, cordate at base, with a narrow or closed sinus, the upper sessile, the lower petioled, and a rather dense, terminal raceme 1' long, of small, white, 4-parted flowers, succeeded by pale red, speckled berries. Sometimes called also *False Lily of the Valley*, about as inappropriate a name as the more common one given above. May, June.

XVI. UVULÀRIA, L. BELLWORT. Rather low, perennial herbs, of eastern North America, with short, creeping rootstocks, fleshy roots, slender, terete stems, nearly naked and simple below, forking and leafy above, oval, ovate, or lanceolate, alternate, *perfoliate leaves*, *smooth on the margin*, and solitary, yellowish flowers on drooping peduncles terminating the branches. Perianth narrowly bell-shaped, the 6 distinct, deciduous segments linear-oblong, acute, erect, each with a honey-groove inside at the base. Stamens 6, anthers linear, adnate,

extrorse, much longer than the short, slender filaments attached to the bases of the segments of the perianth. Style 3-cleft to the middle, the divisions stigmatic along the upper side. *Capsule coriaceous, obovoid, truncate, 3-lobed, 3-celled.* Seeds 1 to 3 in each cell.

Only 2 species.

1. *U. perfoliata*, L. MEALY BELLWORT. A handsome, *pale green*, glabrous, and *glaucous plant*, common in rich woods from Canada to Fla. and Miss., with erect stem, 10' to 15' high, passing through the perfoliate leaves near their bases, forking about the middle, *with usually 1 to 3 leaves below the fork*, the leaves elliptical to ovate-lanceolate, subacute, 2 to 5' long, with rounded base, and the pendulous, pale yellow flowers 10" to 16" long, *granular-scabrous or mealy within*, the segments acute, the stamens shorter than the style, and the anther connective, *with a sharp tip.* May, June.

2. *U. grandiflora*, SMITH. LARGE-FLOWERED OR SMOOTH BELLWORT. A similar plant to No. 1, found in rich woods from Canada to Ga., Tenn., and Mo., but *yellowish-green and not glaucous*, with a stouter stem, 12' to 15' high, *usually having but 1 leaf below the fork*, the leaves narrower, more pointed, and whitish-downy beneath, and the flowers 12" to 18" long, *smooth within and without, the segments acuminate, the stamens longer than the style, and the anther connective, obtuse.* May, June.

XVII. OAKESIA, WATSON. SESSILE-LEAVED BELLWORT. Perennial herbs, of eastern North America, resembling those of *Uvularia*, but with slender, creeping rootstock, acutely angled stems, sessile, rough-margined leaves, the flowers becoming opposite the leaves by the growth of the branches, and the capsule thin, *sharply 3-angled or 3-winged, and acutish at top and bottom or short-stiped.*

About 3 species are known.

1. *O. sessilifolia*, WATSON. (*UVULARIA SESSILIFOLIA*, L.) WILD OATS. A small plant, common in moist and low woods and grassy lands from Me. to Minn. south to Fla. and Ark., with a smooth, slender stem, 6' to 10' high, forking above, smooth, thin, lance-oval, sessile leaves 1' to 3' long, *acute at each end*, dark green above, *paler and glaucous beneath*, and yellowish-white, cylindric flowers, the linear segments 8" to 12" long. *Capsule oval-triangular, stiped.* May, June.

2. *O. pubérula*, Mx. A plant, found in mountain woods from Va. and W. Va. to S.C., similar to No. 1, but *somewhat puberulent*, the stem 8' to 12' high, the leaves oval, *rounded at base, partly clasping, shining green on both sides, puberulent along the margins, larger yellowish flowers, and the capsule ovoid and sessile.* May, June.

ORDER 87. MELANTHACEÆ — BUNCH-FLOWER FAMILY

Perennial herbs, often poisonous, with rootstocks, corms, rarely bulbs, leafy stems or scapes, alternate, broad or grass-like, parallel-veined leaves, and regular, perfect,

dioecious or polygamous flowers, in racemes or panicles or solitary. Perianth of 6 generally similar, green or colored segments, mostly distinct or nearly so, rarely with a long tube, as in *Colchicum*, withering or persistent. Stamens 6, inserted on the base of the segments of the perianth. Anthers mostly extrorse. Styles or sessile stigmas 3, distinct. Ovary free, 8-celled. Capsule mostly septicidal. Seeds few or many.

More than 80 genera and 175 species (Warming), widely distributed, mostly in northern countries.

Key to Genera

- a. Perianth with a long tube. Cultivated exotics *COLCHICUM* *
- a. Perianth with no tube; segments rotate. Native plants. (b)
 - b. Anther cells confluent, extrorse, cordate, peltate after opening. (e)
 - b. Anther cells distinct, extrorse. Capsule loculicidal. (f)
 - b. Anther cells distinct, introrse. Capsule septicidal. (g)
 - c. Flowers panicled. Perianth segments bearing glands. (d)
 - c. Flowers panicled. Perianth segments without glands. (e)
 - c. Flowers racemed, perfect, white *AMIANTHUM* *
 - c. Flowers apiculate, perfect, greenish-white *SCHENOCALON* *
 - d. Perianth segments with conspicuous claws *MELANTHIUM* I
 - d. Perianth segments without distinct claws *ZIGADENUS* *
 - e. Leaves 3-ranked, broad, plaited *VERATRUM* II
 - e. Leaves linear, grass-like *STENANTHIUM* *
 - f. Flowers perfect, white. Radical leaves grass-like *XEROPHYLLUM* *
 - f. Flowers perfect, purple. Leaves all radical *HELONIAS* *
 - f. Flowers dioecious, white. Radical leaves obovate *CHAMÆLIRION* III
 - g. Flowers with 8 involucre bracts *TOPILEDIA* *
 - g. Flowers with no involucre bracts *NARTHECIUM* *

* See floras of Britton, Gray, Wood, and Chapman, and for *Colchicum*, Gray's Field, Forest, and Garden Botany, or Wood's Botanist and Florist.

I. MELANTHIUM, L. BUNCH FLOWER. Perennial herbs, of eastern North America, with thick rootstocks, tall, leafy stems, downy above, linear or oblanceolate but not plaited leaves, and a downy, terminal, large and open, pyramidal panicle, mostly of simple racemes of monœciously polygamous, greenish-white or greenish-yellow flowers. Perianth rotate, of 6 oblong or orbicular, acutish, cordate or auricled, widely spreading segments, bearing 1 or 2 brownish, glandular spots at base, and on slender claws bearing the stamens, the filaments adherent to the claws. Anthers heart-shaped or kidney-shaped, their cells confluent into 1, extrorse and peltate after opening. Styles 3, subulate, diverging; stigmas on their tips. Capsule exserted, subovoid, 3-lobed, tipped with the persistent styles, 3-celled, septicidal, several-seeded. Seeds flat, broadly winged.

Only 8 species known.

1. M. Virginicum, L. COMMON BUNCH FLOWER. A coarse plant, growing in wet meadows, woods, and marshes from New Eng. to Minn.

south to Fla. and Tex., with tall, leafy, rather slender stem, 3° to 5° high, linear, acuminate, sessile leaves, often 1° long, 6" to 12" wide, the lower on a contracted, sheathing base, the upper diminishing in size and nearly sessile, and greenish-yellow flowers, turning brown, about 8" wide, on short pedicels subtended by shorter bracts, in simple, alternate racemes disposed in a terminal, pyramidal panicle 10' to 15' long. Lower flowers generally sterile. Perianth segments ovate or oblong, auricled at base, with 2 dark glands just above the claw. Capsule about 6" long. Seeds, about 10 in each cell, 2" to 3" long. July, Aug.

II. VERATRUM, Tourn. FALSE HELLEBORE. Pubescent, perennial herbs, with short, thick, poisonous rootstocks; coarse, fibrous roots; rather stout, erect, simple stems; strongly veined and plaited, usually broad leaves; and large, terminal panicles of greenish, yellowish, or purple, polygamous or monœcious flowers on short, stout pedicels. Perianth segments 6, adnate to the base of the ovary, spreading, obovate to oblong, sessile, glandless. Stamens shorter than the perianth segments, free from them and recurring. Anthers, pistils, capsules, etc., nearly as in *Melanthium*.

About 10 species, natives of temperate regions of northern hemisphere.

1. V. viride, Ait. AMERICAN WHITE HELLEBORE. INDIAN POKE. A conspicuous plant, very common in swamps and low, wet grounds from Me. to Minn. south to Ga. and Tenn., with a stout, very leafy stem, 2° to 4° high, broadly oval, pointed, 3-ranked, strongly plaited and veined leaves, the lower nearly 1° long and half as wide, sheathing at base, and numerous, yellowish-green flowers in spike-like racemes from the axils of bracts, and forming together a large, terminal, pyramidal panicle. Root emetic, stimulant, poisonous. Common *White Hellebore* is the European *V. album*. June.

III. CHAMÆLIRION, Willd. DEVIL'S BIT. A smooth, erect herb, with a bitter, tuberous rootstock, a slender stem, spatulate, radical, and lanceolate, cauline leaves, and a terminal, wand-like, spiked raceme of small, bractless, white, diœcious flowers, the staminate plant less leafy than the fertile. Perianth of 6 spatulate-linear, spreading, withering-persistent segments. Sterile flowers, with 6 slender filaments longer than the perianth segments, and white, roundish, 2-celled, extrorse anthers. Fertile flowers, with rudimentary stamens and an oblong, free ovary, and 3 distinct, short, linear-club-shaped styles, stigmatic along the inner side. Capsule oblong, loculicidally 3-valved from the summit. Seeds many, linear-oblong, winged at each end.

Genus monotypic, confined to eastern North America.

1. C. luteum, Gray. (C. CAROLINIANUM, Willd.) BLAZING STAR. A plant, growing in low grounds and moist meadows from New Eng. to Mich. and Neb. south to Ga. and Ark., with a furrowed stem, 12' to 30'

high, oblanceolate, obtuse, clustered, radical leaves 3' to 5' long, lanceolate to linear and bract-like stem ones, and the flowers in a raceme 3' to 9' long; the staminate usually more slender and nodding, the fertile erect. May, June.

ORDER 88. PONTEDERIACEÆ — PICKEREL-WEED FAMILY

Perennial, aquatic herbs, with parallel-veined, petioled leaves, and more or less irregular, perfect, solitary or clustered flowers from a spathe. Perianth 6-parted, free from the ovary, the divisions colored alike, often circinate after flowering. Stamens 3 or 6, usually unequal, inserted in the base or tube of the perianth. Ovary 3-celled or 1-celled. Style 1; stigma lobed or toothed. Fruit a more or less 3-celled, many-seeded capsule, or a 1-celled, 1-seeded utricle. Embryo slender and central in floury albumen.

From 4 to 6 genera and 22 to 25 species, natives mostly of warm and temperate regions of America, a few in tropical Asia and Africa.

Key to Genera

Flowers irregular, blue. Stamens 6. Utricle 1-seeded . . .	PONTEDERIA	1
Flowers regular, salver-shaped. Stamens 8. Capsule many-seeded	HETERANTHERA	*

* See floras of Gray, Britton, Wood, etc.

I. PONTEDERIA, L. PICKEREL WEED. Stout, American herbs, found in shallow water, with strong, creeping rhizomes, radical, long-petioled leaves, generally cordate at base, and a 1-leaved, erect stem, sheathed at base by several, bract-like leaves, and terminated by a peduncled spike of ephemeral, blue flowers, the peduncle subtended by a spathe-like bract. Perianth funnel-shaped, tubular at the base, 2-lipped, the upper lip 3-lobed, lower of 3 spreading segments, circinate after flowering, and persistent. Stamens 6; the 3 anterior inserted at the top of the tube; the 3 posterior, often sterile, unequally inserted near the base of the tube; anthers blue. Ovary 3-celled; 2 cells abortive. Utricle 1-seeded, inclosed in the base of the perianth.

About 7 species are recognized.

1. P. cordata, L. COMMON PICKEREL WEED. A conspicuous plant, growing in the borders of muddy ponds and streams from Me. to Minn. south to Fla. and La., with a round stem, rising 1° to 2° out of the water, bearing a single, smooth, glossy, cordate-oblong, nearly sagittate, obtuse, entire leaf 4' to 7' long, the veins conforming to the margin, and a dense,

cylindric spike of purplish-blue, rarely white flowers about 4" long, with a curved tube slightly longer than the lobes, on a peduncle longer than the petiole. Var. *angustifolia*, Torr., has the leaves narrower and truncate or only subcordate at base. Var. *lanceifolia*, Morong, or *P. lanceifolia*, Muhl., has lanceolate leaves, rounded or narrow at base. June to Oct.

ORDER 89. COMMELINACEÆ — SPIDERWORT FAMILY

Perennial or annual herbs, with chiefly fibrous roots, jointed stems, flat leaves, usually sheathing at the base, and regular or irregular, mostly perfect flowers. Perianth of 3 herbaceous, rarely colored, persistent sepals, and 3 fugaceous, or deciduous petals. Stamens 6, hypogynous, some of them sometimes imperfect; anthers 2-celled. Ovary superior, 2 to 3-celled, cells 1 to few-ovuled. Styles and stigmas united into one. Capsule 2 to 3-celled, loculicidally 2 to 3-valved. Seeds solitary or few in each cell. Embryo small, opposite the hilum, in fleshy albumen.

About 25 genera and 320 species, mostly tropical.

Key to Genera

Petals unequal. Perfect stamens 8; filaments naked **COMMELINA** *
 Petals equal. Perfect stamens 6; filaments bearded **TRADESCANTIA** †

* See floras of Gray, Britton, Wood, etc.

I. TRADESCANTIA, L. SPIDERWORT. American, perennial, somewhat mucilaginous herbs, with mostly erect, nearly simple stems, alternate, ovate to long-linear-lanceolate, sheathing leaves, and showy, regular flowers, usually in umbelled, terminal, or terminal and axillary clusters subtended by 2 or 3 usually long, leafy bracts. Flowers regular. Sepals mostly herbaceous, persistent. Petals ovate or suborbicular, sessile. Stamens all fertile, the alternate ones sometimes shorter; filaments usually bearded; anthers kidney-shaped.

Nearly 40 species have been recognized, of which 6 are found in our area.

Native plants	Nos. 1, 2
Cultivated plants	No. 8

1. T. Virginica, L. COMMON SPIDERWORT. A smooth or slightly pubescent, more or less glaucous plant, common in moist meadows and prairies and rich soils from N.Y. to Ohio and Minn. south to Fla. and Tex., with fleshy-fibrous roots, a thick, round, jointed, erect, simple or branched stem, 2° to 3° high, sessile, lance-linear or linear, long-acuminate leaves 12' to 18' long, 6" to 12" wide, channeled above, and rich blue, rarely white flowers 1' to 2' wide, in terminal and solitary umbels sub-

tended usually by a pair of bracts similar to but rather shorter and wider than the leaves. Very variable; some forms probably distinct species and so recognized by some botanists, for which see Gray, Wood, Britton, and Chapman. The viscid juice spins into thread; whence the common name. May to Aug.

2. *T. rosea*, VENT. ROSE-COLORED SPIDERWORT. A small plant, growing in sandy, dry, or moist woods from Md. to Mo. south to Fla. and Tex., with a *running rootstock*, a slender, erect stem, 6' to 10' high, narrowly linear, glabrous, grass-like, amplexicaul, channeled leaves 6' to 8' long, and *rose-colored flowers*, 6" to 8" wide, in a few-flowered, terminal umbel subtended by 2 or 3 subulate bracts on a long peduncle. April to Aug.

3. *T. fluminensis*, VELL. WANDERING JEW. A smooth plant, from Brazil and Argentina, common in greenhouses and hanging baskets, with trailing stems rooting at the conspicuous joints, ascending, terminal shoots, shining, green, usually striped, ovate, acute leaves 1' to 2' long, sheathing at base, and small, white flowers, hairy inside, in a sessile umbel subtended by 2 unequal, leaf-like bracts. Forms with yellow- and white-striped leaves, reddish-purple beneath, occur.

N.B.—Two other plants, known as *Wandering Jew* and common in cultivation, are scarcely distinguishable from this, when not in flower. They are a Mexican plant, *Zebrina pendula*, SCHNIZL. (*T. zebrina* and *T. tricolor* of the florists), with *red flowers on a white tubular base*, and the *sheaths hairy at top and bottom or throughout*, the leaves redder beneath and silvery-white and purplish above, the center and margin purple-striped; and a cosmopolitan plant, native in our Southern States, *Commelina nudiflora*, L., with *blue flowers*, and the *sheaths glabrous*, while *T. fluminensis* has the *sheaths hairy or ciliate only at the top*. The blue-flowered species is hardy, the others are not. All are found in cultivation with striped leaves.

§ VII. GLUMACEOUS PLANTS

Flowers inclosed or subtended by chaff-like bracts or *glumes*, but with no proper calyx or corolla, though these are sometimes represented by minute scales or bristles. Stems of the kind called *culms*.

ORDER 90. CYPERACEÆ—SEDGE FAMILY

Tufted, grass-like or rush-like herbs, with fibrous roots, sometimes rootstocks; mostly solid, often angular stems (*culms*); mostly linear and channeled leaves, 3-ranked when cauline, arising from closed, tubular sheaths; and perfect or unisexual flowers arranged in spikes, usually one in the axil of each imbricated, bract-like scale called a *glume*. Perianth none, sometimes represented by hypogynous bristles or scales. Stamens mostly 3; anthers innate (terminal), 2-celled. Ovary 1-celled, with 1 erect, anatropous ovule, becoming a crustaceous or bony akene

in fruit, which is lens-shaped or plano-convex when the style is 2-cleft, or 3-angled when the style is 3-cleft. Embryo minute, in the base of the albumen.

About 65 genera and nearly 8000 species are recognized, abounding in all climes and localities, but most numerous in the wet or moist grounds of temperate regions. Of little use for food or in the arts, being without the sweet and nutritious properties of the grasses, they nevertheless serve useful ends in the economy of nature.

ORDER 91. GRAMINEÆ—GRASS FAMILY

Annual or perennial herbs, rarely woody or tree-like, with fibrous roots, mostly hollow, jointed stems or culms, the joints closed; alternate, 2-ranked leaves on tubular sheaths usually split down to the nodes on the side opposite the blade, the sheath usually bearing at the top a scarious appendage called a *ligule*; and hypogynous, perfect or unisexual flowers in little spikelets of 1 or several, with imbricated, alternate, 2-ranked, chaff-like bracts, and collected in spikes, racemes, or panicles. The lowest bracts of the spikelet, usually 2, sometimes 1, are barren or empty, like the involucre of an umbel or head, and are now usually known simply as *glumes*. The upper bracts are of 2 kinds, outer ones, sometimes awned, now usually called *flowering glumes*, instead of the former term, *outer palet* or *pale*, which inclose each, on the opposite side of the axis, a smaller, thinner one, usually 2-nerved or 2-keeled, but never awned, now usually called a *palet* instead of the former term, *inner palet* or *pale*. Above and inside each *palet*, in complete flowers, are 2 or 3 very minute scales, called *lodicules*, beneath the flower proper. The latter consists of 1 to 6 stamens, usually 3, with versatile anthers of 2 distinct cells. Ovary 1-celled, 1-ovuled, with 2 styles and 2 feathery stigmas. Fruit a seed-like grain or *caryopsis*. Embryo small, lateral, at the base of the floury albumen.

A very large and important family, embracing, according to Warming, about 815 genera and 8500 species, distributed in all parts of the globe. Their usefulness to mankind is epitomized in Ruskin's happy phrase, "the gift-bearing grasses," wheat, corn, rye, oats, barley, rice, and the sugar cane, being all true grasses as much as many others used for the sustenance of the animal creation or in the industrial arts. No poisonous species is known except the poisonous darnel, *Lolium temulentum*, the seeds of which are poisonous. The poisonous and medicinal *spurred rye* or *ergot* is no exception, as it is a parasitic fungus on the rye.

GLOSSARY

- Abortion.** Lack of development of an organ.
- Abortive.** Undeveloped or fruitless.
- Abruptly pinnate.** Pinnate with no odd leaflet at the end.
- Acaulescent.** Stemless or apparently so.
- Accumbent** (cotyledons). Having the edges against the radicle.
- Achene.** Same as *Akene*.
- Achlamydeous.** Without calyx or corolla.
- Acicular.** Finely needle-shaped.
- Aculeate.** Prickly; covered with prickles.
- Acuminate.** Tapering to a slender point.
- Acute.** Ending in a sharp or well-defined angle.
- Adnate.** United, as the inferior ovary with the calyx tube.
- Adventive.** Recently or incompletely naturalized.
- Akene.** A small, 1-celled, 1-seeded, dry fruit.
- Albumen.** Any nutrient material accompanying the embryo.
- Albuminous.** Having albumen.
- Alpine.** Belonging to high mountains.
- Alternate.** Not opposite; placed alternately on the axis or receptacle.
- Alveolate.** Honeycombed; having angular pits like a honeycomb.
- Ament.** A catkin, or peculiar scaly spike of usually unisexual flowers.
- Amentaceous.** Catkin-bearing, or catkin-like.
- Amphitropous** (ovule or seed). Half-inverted and straight.
- Amplexicaul.** Stem-clasping.
- Anatropous** (ovule or seed). Inverted.
- Androgynous** (inflorescence). Containing both male and female flowers.
- androus.** In composition, having stamens.
- Angiospermous.** Having the seeds inclosed in a pericarp.
- Annual.** Lasting only one year. *Winter annual*, a plant which, sown in autumn, blooms and fruits the next spring.
- Annular.** In the form of a ring.
- Anterior** (in a flower). On the front side, i. e. next the bract, or away from the axis of inflorescence; opposed to posterior.
- Apetalous.** Having no petals.
- Apical.** Situated at the apex or tip.
- Apiculate.** Ending in a short, pointed tip.
- Appressed.** Lying close against some surface.
- Aquatic.** Growing in water.
- Arachnoid.** Cobwebby; of slender, entangled hairs.
- Arillate.** Having an aril.
- Aristate.** Awned.
- Articulate.** Jointed; having a node or joint.
- Ascending.** Rising obliquely, or curving upward. *Ascending ovule*, one attached above the base of the ovary, and directed upward.
- Assurgent.** Ascending.
- Attenuate.** Slenderly tapering; becoming slender.
- Auricle.** An ear-shaped appendage.
- Auriculate.** Auricled.
- Awl-shaped.** Narrowed upward from the base to a slender or rigid point.
- Awn.** A bristle-like process; as, the beard of wheat.
- Axil.** The angle formed by a leaf or a branch with the stem.
- Axile.** Situated in or belonging to the axis.
- Axillary.** Situated in an axil.
- Axis.** The central line of an organ or the support of a group of organs; a stem, etc.
- Baccate.** Berry-like; pulpy throughout.
- Barbed.** Furnished with stiff points or short bristles, usually reflexed.
- Barbellate.** Finely barbed.
- Barbulate.** Finely bearded.
- Beaked.** Ending in a beak or prolonged tip.
- Bearded.** Bearing a long awn; furnished with long or stiff hairs, or sometimes awned, as barley.
- Berry.** A fleshy, thin-skinned pericarp with the seeds loosely embedded in the pulp; as, the Currant, Grape, etc.
- Bi- or Bis-.** A Latin prefix signifying two, twice, or doubly.
- Bidentate.** Having two teeth.
- Biennial.** Of two years' duration.
- Bifid.** Two-cleft.
- Bilabiate.** Two-lipped.
- Bineural.** Having both stamens and pistils.
- Bladdery.** Thin and inflated.
- Blade** (of a leaf). The expanded portion.

- Bloom.** The whitish powder on some leaves, fruit, etc.
- Erect.** A modified leaf, usually small, subtending a flower or belonging to an inflorescence, or sometimes cauline.
- Bracteate.** Having bracts.
- Bracteolate.** Having bractlets.
- Bractlet.** A secondary bract, as one on a pedicel.
- Aristle.** A stiff or sharp hair.
- Bulb.** A subterranean leaf-bud with fleshy scales or coats.
- Bulbiferous.** Bearing bulbs.
- Bulblet.** A small bulb, especially one borne upon the stem.
- Bulbous.** Resembling or bearing a bulb or bulbs.
- Caducous.** Falling off very early.
- Calyculate.** Having an outer calyx or calyx-like involucre.
- Campanulate.** Bell-shaped; cup-shaped, with a broad base.
- Cannalulate.** Longitudinally channeled.
- Canescent.** Hoary with gray pubescence.
- Capitate.** Shaped like a head; collected into a head or dense cluster.
- Capular.** Belonging to or like a capsule.
- Carinate.** Having a keel or a projecting ridge on the lower surface.
- Cartilaginous.** Firm and tough in texture, like cartilage.
- Caruncle.** An appendage near the hilum of a seed.
- Carunculate.** Having a caruncle.
- Catkin.** An ament.
- Caudate.** Having a slender tail-like appendage.
- Caudex.** The perennial base of an otherwise annual, herbaceous stem.
- Caulescent.** Having a distinct stem.
- Cauline.** Belonging to the stem.
- Chaff.** Small, thin scales or bracts, becoming dry and membranous on the receptacle of the Composites.
- Chaffy.** Having or resembling chaff.
- Channeled.** Deeply grooved lengthwise.
- Ciliate.** Fringed with marginal hairs.
- Ciliate.** Minutely ciliate.
- Circinate.** Colled from the top downward, as the young frond of a fern.
- Circumscissile.** Opening by a regular transverse circular line of division.
- Cirrhous.** Furnished with a tendril.
- Clavate.** Club-shaped; gradually thickened upward.
- Claw.** The narrow petiole-like base of some petals, as in the Pinks.
- Cleft.** Cut nearly or about to the middle.
- Cleistogamous.** Fertilized in the bud; cleistogamic.
- Cluster.** Any assemblage of flowers on a plant.
- Clustered.** Collected in a bunch of any sort.
- Columnar.** Like a column.
- Commisures.** The line of contact of two carpels, as in the Umbelliferae.
- Comose.** Furnished with a coma or tuft of hairs.
- Compound.** Consisting of two or more similar parts united into one whole. *Compound leaf*, one divided into separate leaflets.
- Compressed.** Flattened laterally.
- Confluent.** Running into each other; bled into one.
- Coniferous.** Cone-bearing.
- Connate** (of opposite leaves). United by their bases, so as to form one leaf.
- Connective.** That part of a stamen which connects the two cells of the anther.
- Connivent.** Coming together; converging.
- Convergent.** Approaching each other.
- Cordate.** Heart-shaped with the point upward.
- Coriaceous.** Tough and leathery.
- Corm.** A solid bulb, as of a Crocus.
- Corrugated.** Wrinkled or in folds.
- Corymbose.** In corymba, or corymb-like.
- Cosmopolite.** Found in most parts of the globe (of plants).
- Creeping.** Running along or beneath the ground and rooting.
- Crenate.** Dentate with the teeth rounded.
- Crenulate.** Finely crenate.
- Crested, Cristate.** Bearing crest-like appendage.
- Crown.** An erect, scale-like, inner appendage to a petal, or to the throat of a corolla.
- Cruciform.** Cross-shaped.
- Crustaceous.** Hard and brittle in texture.
- Cucullate.** Hooded or hood-shaped; cowlid.
- Culm.** The peculiar stem of sedges and grasses.
- Cuneate.** Wedge-shaped, with the acute angle downward.
- Cuspidate.** Tipped with a sharp, stiff point.
- Cyanic.** Blue or any color except yellow.
- Cylindraceous.** Somewhat or nearly cylindrical.
- Cymose.** Bearing cymes, or cyme-like.
- Deciduous.** Not persistent; not evergreen.
- Decomposed.** More than once compound or divided.
- Decumbent.** Reclining on the ground, but with the summit ascending.
- Decurrent** (leaf). Running down the stem below the insertion.
- Decurved.** Curved downward.
- Decussate.** Alternating in opposite pairs at right angles, or in threes.
- Definite.** Of a constant number, not exceeding twenty.
- Deflexed.** Bent or turned abruptly downward.

Dehiscent. Opening regularly by valves, slits, etc., as a capsule or anther.

Deltoid. Shaped like the Greek letter Δ.

Dentate. Toothed, usually with the teeth directed outward.

Denticulate. Minutely dentate.

Depressed. Slightly flattened from above.

Di-, Dis-. A Greek prefix signifying two or twice.

Diadelphous (stamens). Combined in two sets.

Diandrous. Having two stamens.

Dichotomous. Forking regularly in pairs.

Dicotyledonous. Having two cotyledons.

Idiymous. Twin; found in pairs.

Didynamous (stamens). In two pairs unequal in length.

Diffuse. Widely or loosely spreading.

Digitate (fingered). Compound, with the members borne at the apex of the support, as in the leaf of a Horse-chestnut.

Dimidiate. In halves, as if one half were wanting, as the anthers of Sage.

Dimorphous. Of two forms.

Diocious. Unisexual, with the two kinds of flowers on separate plants.

Discoid. Resembling a disk. *Discoid head*. In Compositae, one without ray flowers.

Disk. An expansion of the receptacle at or around the base of the pistil. In Compositae, the tubular flowers of the head as distinct from the ray.

Dissected. Cut into numerous segments, or lobes.

Dissepiment. A partition in an ovary or fruit.

Distichous. In two ranks.

Distinct. Separate; not united; evident.

Divericate. Widely divergent.

Divergent. Inclined away from each other.

Divided. Lobed to the base.

Dorsal. Upon or relating to the back or outer surface of an organ.

Drupaceous. Like or of the nature of a drupe.

Drupe. A fleshy or pulpy fruit with its inner portion (1-celled and 1-seeded, or sometimes several-celled) hard or stony; as a Peach, Plum, or Cherry.

Drupelet. A diminutive drupe.

E- or Ex-. A Latin prefix having often a privative signification, as *ebracteate*, without bracts.

Echinate. Bset with prickles.

Effuse. Very loosely spreading.

Ellipsoidal. Of solids, elliptical in outline.

Elliptical. In the form of an ellipse; oval.

Emarginate. With a shallow notch at the end.

Embryo. The germ.

Emersed. Raised out of the water,

Endogenous. Growing throughout the substance of the stem instead of by successive, consecutive, superficial layers.

Entire. Without toothing or division.

Ephemeral. Lasting only for one day.

Epiphyte. A plant growing on another plant, but not parasitic; an air plant.

Equant. Straddling; said of conduplicate leaves, infolding each other in two ranks, as in Iris.

Erect. Vertical; upright from the plane of the base.

Erode. As if gnawed.

Exalbuminous. Without albumen.

Exfoliating. Falling off in thin layers, as bark.

Exogenous. Growing by successive annular layers near the surface; belonging to the Exogens.

Exserted. Projecting; as stamens from a corolla.

Exstipulate. Without stipules.

Extrores. Facing outward.

Falcate. Scythe-shaped; curved and flat, like a scythe or sickle.

Farinaceous. Containing starch; starch-like.

Farinose. Covered with a meal-like powder.

Fascicle. A close bundle or cluster.

Fastigiate (branches). Erect and near together, as in the Lombardy Poplar.

Ferruginous. Rust color.

Fertile. Capable of producing fruit, or productive, as a flower with a pistil or an anther with pollen.

Filament. The part of a stamen which supports the anther; any thread-like body.

Filamentous. Composed of threads.

Filiferous. Thread-bearing.

Filiform. Thread-shaped; long, slender, and terete.

Fimbriate. Fringed.

Fimbriolate. Having a minute fringe.

Fingered. Digitate.

Fistular. Hollow and cylindrical.

Flaccid. Without rigidity; lax and weak.

Fleshy. Succulent; juicy; of the consistence of flesh.

Fleuous. Zigzag; bending alternately in opposite directions.

Floccose. Clothed with locks of soft hair or wool.

Follicaceous. Of leaf-like texture or appearance.

foliate Having leaves.

foliolate Having leaflets.

Follicle. A fruit consisting of a single carpel, opening by the ventral suture.

Follicular. Like a follicle.

Forked. Divided into nearly equal branches.

Free. Not adnate to other organs.

Friable. Easily crumbled,

Fruit. The seed-bearing product of a plant, simple, compound, or aggregated, of whatever form.

Fugacious. Falling or fading very early.

Fuscesc. Grayish-brown.

Fusiform. Spindle-shaped; thickest in the middle and tapering to each end.

Galea. A helmet-shaped body, as the upper sepal of Aconitum, and the upper lip of some 2-lipped corollas.

Galeate. Helmet-shaped; having a galea.

Gamopetalous. With the petals of the corolla more or less united.

Gemmiparous. Producing gemmæ.

Genuculate. Bent abruptly, like a knee.

Gibbous. Protuberant or swollen on one side.

Glabrate. Somewhat glabrous, or becoming glabrous.

Glabrous. Smooth, in the sense of without hairs or pubescence.

Gland. A secreting surface or structure; any projection or appendage resembling such an organ.

Glandular. Bearing glands or of a gland-like nature.

Glaucous. Covered or whitened with a bloom.

Globose, Globular. Spherical or nearly so.

Glochidiate. Barbed at the tip.

Glomerate. Compactly clustered.

Glumaceous. Furnished with or resembling glumes.

Glume. A chaffy bract in the inflorescence of Grasses.

Granular. Composed of small grains.

Gregarious. Growing in groups or clusters.

Gymnospermous. Having naked seeds, without an ovary.

Gynandrous. Having the stamens united with the pistil, as in the Orchidaceæ.

Habit. The general aspect of a plant.

Habitus. The natural place of growth of a plant.

Halberd-shaped. The same as Hastate.

Hastate. Like an arrowhead, but with the basal lobes pointing outward nearly at right angles.

Head. A dense, round or roundish cluster of sessile or nearly sessile flowers.

Heart-shaped. Of the conventional heart shape with the sinus at the base.

Herb. A plant without a woody stem.

Herbaceous. Not woody; leaf-like in color and texture.

Heterogynous. Having two kinds of flowers.

Hirsute. Pubescent with rather coarse or stiff hairs.

Hispid. Beset with rigid or bristly hairs or with bristles.

Hispidulous. Minutely hispid.

Hairy. Grayish-white with a fine, close pubescence.

Homogamous. Having but one kind of flowers.

Hooded. Shaped like a hood or cowl.

Hyaline. Transparent or translucent.

Hybrid. A cross breed of two species.

Hypogynous. Inserted on the receptacle beneath the ovary and free from it and from the calyx; having the petals and stamens so inserted.

Imbricate or Imbricated. Overlapping, either vertically or spirally.

Immersed. Growing wholly under water.

Inced. Cut sharply and irregularly, more or less deeply.

Included. Not projecting from the surrounding envelope.

Incumbent (cotyledons). Lying with the back of one against the radicle.

Indefinite (stamens). Inconstant in number or very numerous.

Indehiscent. Not opening by valves, etc.

Indigenous. Native and original to the country.

Indurated. Hardened.

Inequilateral. Unequal-sided.

Inferior. Lower or below; outer or anterior. *Inferior ovary*, one that is adnate to the calyx.

Inflated. Bladdery.

Inflorescence. The flowering part of a plant, and especially the mode of its arrangement.

Infra-. In composition, below; as *infra-axillary*, below the axil.

Inserted. Attached to or growing out of.

Inter- or intra-. In composition, between.

Interfoliaceous. Between the leaves of a pair, as the stipules of many Rubiaceæ.

Internode. The portion of a stem between two nodes.

Intramarginal. Within and near the margin.

Introrse. Facing inward or toward the axis.

Involucl. A secondary involucre, as that of an umbellet in the Umbellifera.

Involucellate. Having an involucl.

Involucral. Belonging to an involucre.

Involucrate. Having an involucre.

Involucre. A circle or collection of bracts surrounding a flower cluster or head, or a single flower.

Involute. Rolled inward.

Irregular (flower). Unequal in the size, form, or union of its similar parts.

Keel. A central, dorsal ridge, like the keel of a boat; the two anterior, united petals of a papilionaceous flower.

Kidney-shaped. Crescent-shaped with the ends broad and rounded; reniform.

Labiate. Lipped; belonging to the Labiate.

Lacerate. Irregularly cleft as if torn.

Lucinate. Sashed; cut into narrow, pointed lobes.

Lanceolate. Shaped like a lance head, broadest above the base and narrowed to the apex.

Lateral. Belonging to or borne on the side.

Law. Loose and slender.

Leaflet. A single division of a compound leaf.

Legume. The fruit of the Leguminosae.

Leguminous. Pertaining to a legume or to the Leguminosae.

Lenticular. Lentil-shaped; shaped like a double-convex lens.

Ligulate. Furnished with a ligule.

Ligule. A strap-shaped corolla, as in the ray flowers of the Compositae; a thin, scarious projection from the summit of the sheath in Grasses.

Liliaceous. Lily-like; belonging to the Liliaceae.

Limb. The expanded portion of a petal or a gamopetalous corolla.

Linear. Long and narrow, with parallel margins.

Lip. The upper or lower division of a bilabiate corolla or calyx; the peculiar petal in Orchids.

Lobe. Any segment of an organ, especially if rounded.

Lobed. Divided into or bearing lobes.

Locular. In composition, -celled.

Loculicidal. Opening into the cavity of a cell through the dorsal suture.

Lunate. Shaped like a half-moon or crescent.

Lyrate. Pinnatifid with a large and rounded terminal lobe, and the lower lobes small.

Marcascent. Withering but persistent.

Marginal. Along or near the edge.

Mealy. Farinaceous.

Membranaceous, Membranous. Thin, flexible, and more or less translucent.

Meri carp. One of the akene-like carpels of the Umbelliferae.

-merous. In composition, having parts, as 2-merous, having two parts of each kind.

Midrib. The main or central rib of a leaf.

Mitriform. Shaped like a miter or cap.

Monadelphous (stamens). United by their filaments into one set.

Moniliform. Resembling a string of beads; cylindrical with contractions at intervals.

Monocotyledonous. With but one cotyledon.

Monocious. With stamens and pistils in different flowers on the same plant.

Monotypic. Having but one type or representative, as, a *monotypic* genus, a genus having but one known species.

Mucronate. Tipped with a short, abrupt tip.

Multifid. Many-cleft.

Muricate. Beset with short, hard points.

Naked. Without the usual covering or appendages.

Nectariferous. Producing nectar.

Nectary. Any place or organ for secreting nectar.

Nerve. A simple vein or slender rib.

Nodose. Knotty or knobby.

Numerous. Indefinite in number.

Nut. A hard, indehiscent, one-celled and one-seeded fruit, though usually resulting from a compound ovary.

Nutlet. A diminutive nut.

Ob- A Latin prefix, usually meaning inversely.

Obcompressed. Compressed on the back and front instead of laterally.

Obconical. Inversely conical, i.e. attached at the apex.

Obcordate. Inversely heart-shaped.

Ob lanceolate. Inversely lanceolate.

Oblique. Unequal-sided or slanting.

Oblong. Considerably longer than wide, with the sides nearly parallel.

Obovate. Inversely ovate.

Obovoid. Inversely ovoid.

Obsolete. Indistinct; rudimentary.

Obtuse. Blunt or rounded at the end.

Ochroleucous. Yellowish-white.

Ocrea. A leggin-shaped or sheathing stipule.

Ocreate. Having sheathing stipules.

Odd-pinnate. Pinnate with an odd leaflet at the end.

Officinal. Of the shops; used in medicine or the arts.

Opaque. Dull; not smooth and shining.

Operculate. Furnished with a lid.

Operculum. A lid; the upper portion of a circumscissile capsule.

Orbicular. Circular.

Oval. Broadly elliptical.

Ovate. Egg-shaped; having an outline like that of an egg, with the broader end downward.

Ovoid. Egg-shaped.

Palate. A protuberance of the lower lip of a personate corolla.

Paleaceous. Chaffy.

Palmate (leaf). Radiately lobed or divided.

Palmately. In a palmate manner.

Panicle, Paniculate. Borne in panicles, like a panicle.

Papilionaceous (corolla). Having a standard, wings, and keel, as in the peculiar corolla of the Pea, Bean, or Locust.

Papillose. Covered with minute, nipple-shaped dots.

Parietal. Borne on or pertaining to the wall or inner surface of a capsule.
Parted. Cleft nearly but not quite to the base.
Partial. Of secondary rank.
Pectinate. Finely pinnatifid; comb-like.
Pedate. Palmately divided or parted into narrow segments, like a bird's foot, with the lateral segments cleft and diverging.
Pediceal. The stalk of a single flower.
Pedicellate, Pedicled. Borne on a pedicel.
Peduncle. A primary flower stalk, supporting either a cluster or a solitary flower.
Pedunculate. Borne upon a peduncle.
Peltate. Shield-shaped, with the stalk attached to the lower surfaces.
Pendulous. Hanging down or drooping.
Perennial. Lasting year after year.
Perfect (flower). Having both pistil and stamens.
Perfoliate (leaf). Apparently pierced by the stem.
Persistent. Remaining after the usual period, as a calyx upon the fruit, leaves through winter, etc.
Petaloid. Colored and like a petal.
Petiolate. Having a petiole.
Petiole. The footstalk of a leaf.
Pilose. Hairy, especially with soft hairs.
Pinnate (leaf). Compound, with the leaflets "on each side of a common petiole.
Pinnatifid. Pinnately cleft.
Pitted. With small depressions or pits.
Plumose. Feather-like, as the pappus bristles of *Thistles*.
Pod. Any dry, dehiscent fruit.
Posterior. Next the axis.
Præmorse. Ending abruptly as if bitten off.
Prickle. A small spine or sharp projection from the bark or rind.
Prismatic. Prism-shaped, with several parallel, longitudinal angles.
Prooumbent. Lying on the ground.
Proliferous. Producing offshoots; or reproducing, as a flower, or head or cluster of flowers out of another.
Prostrate. Lying flat upon the ground.
Proterogynous. Having the stigma ready for the pollen before the ripening of the anthers of the same flower.
Puberulent. Minutely pubescent.
Pubescent. Covered with short, soft, and downy hairs.
Punctate. Dotted, as if with minute holes, or with colored dots.
Pungent. Sharp-pointed; acrid.

Radiate. Diverging from a common center; producing ray flowers.
Radical. Belonging to or growing from the root or base of the stem.
Ray. The branch of an umbel; a marginal flower of a head or of an inflorescence.

Recurved. Curved downward or backward.
Reflexed. Abruptly bent or turned downward.
Reniform. Kidney-shaped.
Repend. With a slightly wavy margin.
Reticulate. Net-veined.
Retrorse. Directed back or downward.
Revsed. Slightly notched at a rounded apex.
Rhizome. Any prostrate or subterranean stem, usually rooting at the nodes and becoming erect at the apex.
Rhombic, Rhomboidal. Somewhat lozenge-shaped; obliquely 4-sided.
Rib. A primary or prominent vein of a leaf.
Rootstock. Same as *Rhizome*.
Rostate. Beaked or spurred.
Rosulate (leaves). Arranged around the base of the stem like a rosette.
Rotata (corolla). Wheel-shaped.
Rudiment. A very slightly developed organ.
Rudimentary. But slightly developed.
Rugose, Rugous. Wrinkled.
Runcinate. With sharp segments directed backward.

Saccate. Sac-shaped.
Sagittate. Like an arrowhead, with the basal lobes directed downward.
Salver-shaped (corolla). With a slender tube abruptly spreading into a flat limb.
Scabrous. Rough to the touch.
Scapæ. A naked, or nearly naked, peduncle rising directly from the ground.
Scarious. Thin, dry, and not green.
Scorptoid (inflorescence). Circinately coiled while in the bud.
Seed. A ripened ovule.
Segment. A subdivision of a leaf or other like organ when cleft or divided.
Septicidal. Opening through the partition.
Septifragal. With valves breaking from the partitions in dehiscence.
Serrate. With teeth pointing forward.
Serrulate. Finely serrate.
Sessile. Without footstalk of any kind.
Setaeous. Bristle-like.
Sheath. A tubular covering, as the base of the leaf in Grasses.
Sheathing. Inclosing as by a sheath.
Shrub. A small, woody plant, branching near the ground.
Silky. Covered with close-pressed, soft and glossy, straight hairs.
Simple. Of one piece; not compound.
Sinuate. With strongly wavy margin.
Sinus. A recess between two lobes.
Smooth. Without roughness or pubescence.
Spadix. A thick, fleshy axis, with the small, often imperfect flowers closely sessile or embedded, usually inclosed by a spathe.
Spathæ. A large bract or pair of bracts enveloping an inflorescence.

Spatulate. Widening gradually from a narrow base to a rounded summit.

Spicate. In or like a spike.

Spikelet. A small or secondary spike.

Spindle-shaped. Same as *Fusiform*.

Spine. A sharp process originating in the wood.

Spur. A hollow, sac-like or tubular process from some part of a flower, usually nectariferous.

Squarrose. Widely spreading or with the tips spreading, as the involueral scales of some Compositae.

Squarroulose. Diminutively squarrose.

Standard. The upper dilated petal of a papilionaceous corolla.

Stellate, Stelliform. Star-shaped.

Stem. The main axis of a plant.

Sterile. Unproductive, as a flower without pistil, or stamen without an anther.

Stigmatic. Pertaining to or like the stigma.

Stipe. The stalk which sometimes supports an ovary.

Stipel. The stipule of a leaflet.

Stipitate. Having a stipe.

Stipular. Belonging to stipules.

Stipulate. Having stipules.

Stoloniferous. Producing stolons.

Striate. Marked with fine, parallel lines, grooves, or ridges.

Strict. Very straight and erect.

Strigose. Covered with appressed, sharp, straight, and stiff hairs.

Sub-. A Latin prefix, usually signifying somewhat or slightly.

Subulate. Aawl-shaped.

Succulent. Juicy; fleshy.

Sulcate. Grooved or furrowed.

Synonym. A superseded or unused name.

Tail. Any slender, terminal prolongation.

Terete. Round like a column, either tapering or cylindric; used specially of stems or stem-like bodies.

Terminal. At or belonging to the apex.

Ternary. Consisting of three.

Ternate. In threes.

Tetradynamous (stamens). Consisting of four long and two shorter ones.

Throat. The orifice of a gamopetalous corolla, or the part between the proper tube and the limb.

Thyree. A dense, ovoid panicle.

Thyrsoid. Resembling a thyree.

Tomentose. Densely covered with short, woolly or matted hairs.

Tooth. Any small, marginal lobe.

Torose. Cylindrical with swellings at intervals.

Torulose. Diminutive of Torose.

Transverse. Across; in a right and left direction.

Tri-. In composition, three or thrice.

Triandrous. Having three stamens.

Trifoliolate. Having three leaflets.

Truncate. With the end as if cut off transversely.

Tubercle. A small tuber or tuber-like body.

Tuberiferous. Bearing tubers.

Tuberous. Having the nature or appearance of a tuber.

Tumid. Swollen.

Tunicated. With concentric coats, as an onion.

Turbinate. Top-shaped; inversely conical.

Umbellate, Umbelled. In or like an umbel.

Umbellet. A secondary umbel.

Undershrub. A very low shrub.

Undulate. With a wavy edge; repand.

Ungiculate. Contracted at base into a claw.

Uni-. In composition, one.

Unisexual. Of one sex, either staminate or pistillate only.

Urocolate. Urn-shaped.

Utricle. A small, bladdery, 1-seeded fruit.

Valeate. Meeting by the edges without overlapping, as the sepals or petals in aestivation.

Vales. One of the parts into which a dehiscent capsule separates.

Ventricose. Swelling out on one side.

Verrucose. Covered with wart-like excrescences.

Vertical. Perpendicular to the horizon.

Verticillate. Whorled.

Vesicle. A small bladder or air cavity.

Villous. With long and soft hairs.

Virgate. Wand-shaped; long, slender, and straight.

Viscid. Glutinous; sticky.

Whorl. An arrangement of leaves, etc., in a circle round the stem.

Whorled. Arranged in a whorl.

Wing. Any thin expansion bordering or surrounding an organ; the lateral petal of a papilionaceous corolla.

Woolly. Covered with long and tortuous or matted hairs.

Xanthic. Of the yellow type of colors; opposed to cyanic.

INDEX

(SYNONYMS IN ITALICS>

Ables	322	Anemone	15	Ballota	372
Absinth	223	Rue	17	Balsam, Garden	71
Abutilon	68	Anemonella	17	Balsam Apple, Wild	152
Acacia, False	109	Angelica	163	BALSAMINACEÆ	70
Rose	109	Angelica Tree	166	Banberry	24
Three-thorned	110	ANONACEÆ	27	Baptisia	91
ACANTHACEÆ	267	Antennaria	224	Barberry	20
Acanthus Family	267	Anthemis	219	Barberry Family	28
Acer	84	Antirrhinum	257	Bark, Georgia	182
Acerates	300	Apetalous Plants	11, 815-321	Bartonia	305
Achillea	220	Aplos	99	Basil, Field or Stone	278
Aconite	23	APOCYNACEÆ	307	Wild	276, 278
Aconitum	23	Apocynum	307	Basket Flower	229
Acorus	324	Apple	119	Basswood	65
Acorus	24	Crab	119	Bead Tree	74
Actinomeris	214	Apple of Peru	303	Bean	100
Adam's Needle	341	Apple Subfamily	113	Sacred	81
Adder's Tongue	336	Apricot	114	Wild	99
Adiantum	36	Aquilegia	22	Bean Tree	102
Æsculus	82	Arabis	41	Bean Vine, Wild	100
Agave	327	ARACEÆ	322	Bear Grass	341
Agrimonia	123	Arachis	95	Beard Tongue	258, 259
Agrimony	123, 124	Aralla	165	Bedstraw	173, 179
Ague Tree	320	ARALIACEÆ	165	Bee Balm	279
Allanthus	74	Arbor Vitæ	322	Bee Plant, Rocky Moun-	
Aleobia	30	Archangelica	163	tain	47
Albizia	112	Arctium	231	Beech Drops, False	247
Alder, Black	76	Arctostaphylos	241	Beggar's Lice	230
White	245	Argemone	34	Beggar-ticks	216, 217, 230
Alfalfa	105	Arisema	323	Begonia	155
Allama	325	Aronia	113	BEGONIACEÆ	155
ALIACEÆ	325	Arrowhead	326	Belaria	241
Alkekengi	302	Arrowwood	176	Belamcanda	329
Alleghany Vine	37	Artemisia	222	Bellflower	229
All-heal	231	Artichoke, Jerusalem	213	Bellis	300
Alligator Tree	146	Arum Family	322	Bellwort	344, 345
Allium	335	ASCOLEPIADACEÆ	309	Benjamin Bush	320
Allspice, Carolina	134	Asclepias	309	Benseoin	320
Almond	115	Asclepiodora	309	BERBERIDACEÆ	28
Alyssa	62	Ascyrum	58	Berberis	29
Shrubby	64	Ash	812	Berchemia	79
Alum Root	137	Mountain	120	Bergamot, Wild	230
Alyssum	48	Poison	87	Bidens	216
AMARYLLIDACEÆ	326	Prickly	73	Bignonia	252
Amaryllis	328	Astunina	27	BIGNONIACEÆ	251
Amaryllis Family	328	Asparagus	385	Blasted	146
Amelrosia	206	Aster 194, 195, 196, 197, 198	202, 203	Blindweed	290, 313
Amelanchier	120	Golden	194	Bishop's Cap	137
Amelanthium	346	White-topped	194	Bitter Bloom	305
Amorpha	107	Aster Family	186	Bittersweet	301
Ampelopsis	81	Astilbe	186	Climbing or Shrubby	77
Amphicarpæa	101	Atamasco Lily	323	Bitterweed	199
Amsonia	307	Atropa	300	Blackberry	127, 128
Amygdalus	114	Azlea	130	Black-eyed Susan	211
AMACARDIACEÆ	86		244	Bladder Ketmia	64
Anagallis	250	Bachelor's Button	229	Bladder Nut	88
Anaphalis	225	Wild	59	Bladderwort	265
Andromeda	241	Balloon Vine	68	Blanket Flower	218
Androsace	247			Blazing Star	190, 191, 347

Bleeding Heart	87	Campanula	239	Chrysosplenium	136
Blephilia	272	CAMPANULACEÆ	238	Cichorium	223
Bloodroot	84	Campan	58	Cicuta	164
Blue Curia	278	Bladder	58	Cimicifuga	28
Blue Thistle	287	Rose	54	<i>Chenoparia</i>	227
Blue Weed	287	Starry	58	Cinquefoil	133, 138
Bluebells	286	Candytuft	44	Citrea	150
Bluebells of Scotland	239	Cantaloupe	154	CITRACEÆ	47
Bluebottle	229	Canterbury Bells	239	Citrullus	154
Blue-eyed Grass	331	Cape Jasmine	133	Cladrastis	22
Bluets	180, 181	Caper Family	45	Clammy Weed	47
Bocconia	86	CAPPARIDACEÆ	45	Claytonia	57
Boneset	193	CAPRIFOLIACEÆ	170	Cleavers	178, 179
Climbing	194	Capsella	45	Clematis	15
Borage	287	Capsicum	300	Cleome	47
BORAGINACEÆ	285	Caraway	165	Clethra	244
Borago	287	Cardamine	40	<i>Chenopodium</i>	278
Bouncing Bet	58	Cardinal Flower	238	Clintonia	235
Bouvardia	189	Cardiospermum	88	Clothbur	207
Bowman's Root	126	Carnation	53	Clover	103, 104, 105
Box, Chinese	77	Carpet Weed	56	Bokhara or Cabul	106
Boxberry	243	Carrot, Wild	160	Burgundy	105
Boxthorn	304	Carum	164	Bush	96
Brachycheta	203	CARYOPHYLLACEÆ	51	Japan	99
Bramble	126	Cashew or Sumac Family	86	Sweet	105, 106
Brasletto Subfamily	90	Cassena	76	Cnicus	230
Brassica	43	Cassia	109	Cocculus	23
Brier, Cat	332	Cassiope	241	Cocklebur	207, 208
Horse	332	Castilleja	264	Cohosh, Black	24
Brooklime	261	Catalpa	253	Blue	29
Broom, Scotch	103	Catawba Tree	286	Red	24
Brunella	280	Catchfly	58	White	24
Brunnichia	315	Catgut	108	Colchicum	246
Buckeye	32, 38	Catmint	230	Collinsonia	276
Buckthorn	78	Catnip	230	Columbine	22
Buckwheat Family	315	Caulophyllum	39	Comfrey, Wild	290
Bugbane	28	Ceanothus	79	Commelina	349
Bugleweed	275	Cedar, Red	323	COMMELINACEÆ	349
Bullace	81	Stinking	323	Compass Plant	205
Bunch Flower	346	White	323	COMPOSITEÆ	136
Bunch-flower Family	345	Cedronella	273	Coneflower	210, 211
Bunchberry	168	Celandine	84	Purple	309
Bupleurum	159	CELASTRACEÆ	76	CONIFERÆ	321
Bur, Sand	302	Celastrus	77	Coniferous Plants	12, 321, 322
Burdock	231	Centaurus	228	Conium	164
Burning Bush	77	Centunculus	247	<i>Conoclinium</i>	194
Bur-seed	230	Cephalanthus	181	Convallaria	343
Butter and Eggs	256	Cerastium	55	CONVOLVULACEÆ	236
Buttercup	18	Cerasus	114	Convolvulus	236
Butterfly Weed	311	Cercis	109	Coptis	21
Butterweed	227	Cereus	157	Coral Berry	173
Butterwort	265, 266	Night-blooming	156	Coreopsis	214, 215, 216
Button Bush	182	Chamaecyparis	322	Corn Cockle	54
Cabbage	43	Chamaellirion	347	Corn Salad	134
Caecalia	225	Checkerberry	242	CORNACEÆ	167
CACTACEÆ	156	Cheliranthus	41	Cornel	167, 168, 169
Cactus, Giant	157	Chelidonium	84	Cornflower	229
CESALPINIÆ	90, 91	Chelone	258	Cornus	167
Calabash	153	Cherry	114, 115	Corydalis	37
Calamint, Lesser	278	Cornelian	168	Cosmanthus	292
Calamintha	277	Ground	302	Cosmos	217
Calamus	325	Indian	79	Cotton	64
Calendula	228	Chestnut, Horse	82	Cowbane	164
Calico Bush	241	Chickweed	55	Cowslip	247, 248
Calla	328	Indian	56	American	248
Caltha	20	Mouse-ear	55	Virginia	238
CALYCANTHACEÆ	138	Chicory	232	Cow-wheat	265
Calycanthus	134	Chimaphila	246	Cranberry, High	175
<i>Calystegia</i>	293	China Tree	74	Cranberry Tree	175
Camass	339	Chinquapin, Water	31	Crane's-bill	67
Camassia	339	Chionenes	240	CRASSULACEÆ	143
Camellina	44	Chionanthus	314	Crataegus	116
Camellia	60	Chittamwood	87	Crazy Weed	103
Camellia Family	60	Chokeberry	119	Cress, Bitter	40
Camomile	219, 220	Chrysanthemum	221	Bulbous	41
		Chrysopsis	302	Cow	45

Cress, Garden	45	Dockmackie	176	Flag, Sweet	325
Indian	72	Dodder	299	Flax	66
Marsh	89	Dodecatheon	248	False	44
Rock	41	Dogbane	307, 308	Fleabane	199
Spring	41	Dog Fennel	192	Fleur-de-lis	329
Swine	46	Dogwood	167, 168, 169	Flora's Paint Brush	226
Wart	46	Poison	87	Flower-de-luce	329
Crocus	399	Doorweed	317	Flower of an Hour	64
Crookneck	158	Draba	44	Foam Flower	187
Cross Vine	252	Dracocephalum	273	Forestiera	312
Crowfoot	18	Drop Flower	234	Forget-me-not	238, 289
Crowfoot Family	14	Dropwort	125	Foraythia	312
Crown Imperial	389	Drosera	144	Foxglove	260
Crownbeard	213, 214	DROSERACEÆ	144	False or Yellow	262, 263
CRUCIFERÆ	88	DRUPACEÆ	113	Fragaria	181
Cucumber	154	Dusty Miller	297	Frasera	305
One-seeded	152	Dutchman's Breeches	37	Fraxinus	312
Snake	154	Eardrop, Ladies'	149	Fringe Tree	314
Star	152	Echinacea	209	Fritillaria	338
Cucumber Root, Indian	384	Echinocystis	152	Fritillary	338, 339
Cucumber Tree	25	Echinodorus	325	Frostweed or Frost Plant	48
Cucumis	154	Echinopspermum	390	Fuchsia	149
Cucurbita	153	Echium	237	FCMARIACEÆ	36
CUCURBITACEÆ	151	Eglantine	123	Fumitory, Climbing	37
Cudweed	223, 224	Elder	174, 175	Fumitory Family	36
Culver's Root	261	Box	85	Funkia	341
Cunila	375	Marsh	306	Gallardia	318
Cup Plant	205	Poison	87	Galanthus	323
Currant	141	Wild	166	Galeopsis	233
Indian	173	Elecampane	304	Gallinsoga	319
Cuscuta	299	Elephant's Ear	155	Galium	178
Custard Apple Family	27	Elliotia	241	Gall of the Earth	235
Cyclamen	247	Ellisia	291	Gamopetalous Plants	10,
Cydonia	118	Elodea	60	170-315	
Cynoglossum	289	Elodes	59	Gardenia	188
Cynthia	233, 235	Emilia	225	Garget	319
CYPERACEÆ	350	Enchanter's Nightshade	7, 322	Gaultheria	242
Cypress, Bald	297	ENDOGENS	309	Gay Feather	191
Cypress Vine	297	Enselia	242	Gaylussacia	240
Cytisus	102	Epigæa	147	Gelsemium	254
Daffodil	327	Epilobium	235	Gentian	305, 307
Daisy	200	Erechtites	240	Horse	171
Oxeye	231	ERICACEÆ	241	Gentiana	306
Paris	223	ERICINEÆ	163	GENTIANACEÆ	304
Dalibarda	129	Erigeron	198	GENTIANÆÆ	305
Dandelion	235	Eriogonum	315	Georgia Bark	182
Dwarf	239	Erodium	67	GERANIACEÆ	67
Fall	233	Eryngium	159	Geranium	67, 68, 69
False	235	Eryngo	159	Gerardia	263
Dasystoma	249	Erythrae	305	Germander	273
Datura	304	Erythronium	335, 336	Geum	180
Daucus	160	Eachscholtzia	35	Gherkin	154
Dead Nettle	232, 233	Euonymus	292	Gilia	294
Decumaria	139	Eupatorium	192, 193	Gill-over-the-Ground	280
Delphinium	22	Eutoca	292	Gillenla	126
Dentaria	40	Evening Primrose	148	Gingko	322
Desmanthus	112	Everlasting	223, 224, 225	Ginseng	166
Desmodium	96	Exogens	7, 14	Dwarf	166
Deutzia	140	Fagopyrum	315	Ginseng Family	165
Devil's Bit	347	Featherfew	221	Gladolus	329
Devil's Paint Brush	234	Fennel Flower	21	Glaux	247
Dianthera	266	Fetticus	184	Glechoma	280
Dianthus	52	Fever Tree	182	Gleditsia	110
Dicentra	37	Feverfew	221	Glumaceous Plants	13,
Dicerandra	272	Fewer American	206	350, 351	
Dichondra	296	Fewerwort	171	Gnapallum	223
Dicotyledons	7	Figwort	257, 258	Goat's Beard	125
Diervilla	173	Figwort Family	255	False	186
Digitalis	260	Flr	322	Goat's Rue	106
Dionea	145	Balsam	322	Gold-of-Pleasure	44
Diplopappus	195	Fireweed	147, 225	Golden Alexanders	161
DIPSAKEÆ	185	Five-finger	182	Early	162
Dipsacus	135	Flag, Blue	330	Golden Bell	312
Dittany	275			Golden Chain	102
Dock	316			Golden Club	324

Golden Seal	34	Hemp Nettle	268	Indigo, False or Bastard	167
Golden-rod	200, 201, 202	Hempweed, Climbing	194	False	91, 92
False	202	Hen and Chickens	148	Wild	92
Goldthread	21	Henbit	262	Ink Berry	319
Gonolobus	300	Hepatica	17	Inkberry	76
Goose Grass	179	Hieracium	162	Innocence	180
Gooseberry	141, 142	Herb-of-Grace	72	Insula	308
Gordonia	61	Herb Robert	68	<i>Juncus</i>	185
Gnaphalium	64	Hercules's Club	166	Ipecac, American	126
Gonaglyptus	158	Heteranthera	348	Ipomoea	297
Gourd	158	Hesperis	187	IRIDACEÆ	329
Bottle	158	Hibiscus	68	Iris	329, 330
Gooseberry	158	Marsh	68	Ironweed	180, 190
GRAMINEÆ	351	Tree	64	Isoetes	273
Grape	80, 81	Hieracium	228	Isoetes	273
Grass Family	351	High-water Shrub	206	Isoetes	273
Grass-of-Parnassus	188	Hoarhound, Water	274, 275	Ivy, American	81
Greek Valerian	296	Wild	198	Boston	81
Greenbrier	332	Hobblebush	175	English or European	167
Grim-the Collier	234	Holly	75, 76	German	226
Gromwell	287	Hollyhock	62	Japanese	81
Ground Ivy	280	Honesty	43	Kenilworth	256
Ground Nut	166	Honey Balls	182	Poison	87
Groundnut	96, 99	Honey Bloom	306	Jack-in-the-Pulpit	228
Groundsel	226	Honey Locust	110	Jacobea, Purple	227
Guelcher Rose	176	Honey-suckle	173, 174	Jacob's Ladder	296
Wild	175	Bush	173, 174	Jamestown Weed	304
Guinea-ben Flower	339	Cape	358	Jasmine	313, 314
Gum, Cotton	169	Hoodwort	254	Carolina or False	254
Sour	169	Hop Tree	73	Jasminum	318
Sweet	146	Horehound	264, 285	Jeffersonia	218
Tupelo	169	Horse Balm	276	Jerusalem Artichoke	223
Gumbo	64	Horse-cane	307	Jessamine	313, 314
Gymnocladus	111	Horsemint	274	Blue	15
Gymnosperms	331	Horseradish	39	Yellow	254
Gymnosperms	7, 321	Horserweed	199, 207	Jewelweed	71
		Hottonia	247	Jimson Weed	304
Halenia	305	Hound's Tongue	192	Joe Pye Weed	198
HAMAMELIDACEÆ	145	Hound's-tongue	289	Jonquil	327
Hamanella	145	Houseleek	143	Judas Tree	109
Hanging-of-Spring	168	Houstonia	180, 181	June Berry	120, 121
Hardhack	124	Hoya	300	Juniper	322
Hardheads	229	Huckleberry Subfamily	240	Juniperus	322
Harebell	229	Huntman's Cup	33	Kalmia	241
Hare's-ear	160	Hyacinth	340	Kentucky Coffee Tree	111
Haw	116, 117	Grape	339	Kianikinnik	168
Black	176	Wild	340	Knawweed	229
Poison	176	Hyacinthus	183, 189	Knawel	56
Hawkbitt, Autumnal	238	Hydrangea	125	Knight's Spur	23
Hawkweed	288, 294	HYDRANGEÆ	24	Knotgrass	316, 317
Hawthorn	116, 117	Hydrastis	291	German	86
Heal-all	51	Hydrolea	290	Knotweed	316, 317
Heart's-ease	83	HYDROPHYLLACEÆ	291	Kosteletzka	61
Heartseed	240	Hydrophyllum	300	Krigia	223
Heath Family	341	HYPOCISTACEÆ	57	LABIATÆ	271
Heath Subfamily	275	Hypericum	56	LABIATIFLORÆ	157
Hedeoma	166	Hypoxis	246	Labiurnum	102, 108
Hedera	234	Hypoxis	272	Lactuca	226
Hedge Nettle	268, 278	Hyssop, Prairie	277	Lady-in-Green	21
Helenium	218	Hyssopus	272	Lady's Thumb	318
Hellanthemum	48	Iberis	44	Lagenaria	169
Hellanthus	211	Ilex	75	Lambkill	243
Heliopsis	208	ILICACEÆ	75	Lamium	293
Helliotrope	246	Impatiens	71	Lappa	281
Summer	246	Indian Bean	258	Larch	333
Helliotropium	246	Indian Cup	205	Larix	333
Hellebore	21	Indian Hemp	305	Larkspur	22
False	347	Indian Physic	126	Lathyrus	90
White	347	Indian Pipe	246	LAURACEÆ	319
Helleborus	21	Indian Pipe Subfamily	241	Laurel, American or	241
Helianthus	346	Indian Piantain	225	Mountain	241
Hemerocallis	342	Indian Tobacco	228	Rig	26
Hemlock	322	Indian Turnip	328	Great or Big	243
Ground	322			Ground	243
Poison	164				
Water	164				
Hemp, Indian	306				

Laurel, Sheep	342	Lunaria	48	Milkweed, Trumpet	236
Laurel Family	819	Lungwort	288	Milkweed Family	309
Laurestine	177	Lupine	101	Milkwort	88
Lavandula	272	Lupinus	101	Milkwort Family	87
Lead Plant	107	Lychnis	54	Mimosa	111
Leafcup	204	Lycium	306	Mimosa Subfamily	90
Leather Flower	15	Lycopersalum	300	Mimosaæ	90, 91
Ledum	241	Lycopsis	285	Minulus	260
Legume Family	89	Lycopus	274	Mint	274
LEGUMINOSÆ	89	Lysimachia	249	Horse	279
Leptophyllum	241			Mountain	276, 277
LENTIBULARIACÆ	265	Macbridea	272	Stone	275
Leonotis	272	Madder Family	177	Mint Family	271
Leontodon	298	Madwort	28, 48	Mist Flower	194
Leonurus	234	Magnolia	25	Mist Tree	87
Lepidium	45	MAGNOLIACÆ	25	Mitchella	180
Lespedeza	98	Mahogany Family	74	Mitella	187
Lettuce	286, 287	Malanthemum	344	Miterwort	187
White	284, 285	Mallow	63	False	187
Leucanthemum	221	Curled	62	Mock Orange	189, 140
Leucas	272	High	62	Mollucella	272
Leucolum	297	Indian	68	Mollugo	56
Liatris	190	Low	62	Monarda	279
Licorice, Wild	179	Marsh	62	Moneses	241
LIGULIFLORÆ	189	Rose	68, 64	Moneywort	249
Ligustrum	814	Malus	118	Monkey Flower	260
Lilac	818	Malva	62	Monkshood	28
Indian	74	MALVACÆ	61	MONOCOTYLEDONS	7, 322
LILIACÆ	384	Mandrake, Wild	80	Monotropa	246
Lilium	386	Man-of-the-Earth	298	MONOTROPÆ	241
Lily	387, 388	Maple	84, 85	Moonsced	28
Checkered	389	Ash-leaved	85	Moonsced Family	27
Plantain	341	Marguerite	222	Morning-glory	297
Pond	82	Golden	220	Mother of Thyme	277
Water	81	Marigold	228	Motherwort	284
White or Blue Day	341, 342	African	228	Mountain Fringe	87
Yellow Day	342	Bur	217	Mountain Tea	243
Lily Family	384	French	227	Mourning Bride	186
Lily-of-the-Valley	348	Marsh	20	Mugwort	228
Lilimanthemum	306	Mexican	228	Mullein	255
LINACÆ	66	Pot	228	Moth	256
Linaria	256	Sweet-scented	228	Muscadine	81
Linden	65	Marrubium	234	Muscari	340
Lindera	380	Marrubia	220	Muskmelon	154
Linnæa	170	Matrimony Vine	304	Mustard	42
Linum	66	Matthiola	89	Black	42
Lime, Ogeechee	170	May	118	Field	48
Wild	170	Italian	125	Hedge	42
Lime Tree	65	May Apple	80	Indian	48
Lion's Foot	285	Mayflower	242	Tansy	42
Liquidambar	146	Maypop	181	White	42
Lithospermum	287	Mayweed	220	Wild	48
Litsea	320	Meadow Rue	17	Mustard Family	88
Live Forever	148	Meadowsweet	194	Myosotis	298
Liverleaf	17	Medeola	384		
Lobelia	238	Medic	105	Nabalus	234
LOBELIACÆ	237	Medicago	105	Nama	291
Loblobbly Bay	61	Melampyrum	265	Nannyberry	176
Loco Weed	108	MELANTHACÆ	245	Napea	61
Locust	108, 109	Melanthium	346	Narcissus	327, 328
Honey	110	Mella	74	Narthecium	346
LOGANIACÆ	258	MELIACÆ	74	Nasturtium	89, 72
Lonicea	172	Mellot	105	Neckweed	262
LONGICERÆ	170	Mellotus	105	Negundo	85
Loosestrife	249, 250	Melissa	272	Nelumbo	81
Bastard	149	Melon, Rock	154	Nemastylis	329
False	149	MENISPERMACÆ	27	Nemophila	211
Lophanthus	272	Menispermum	27	Nepeta	220
Looseed	270	Mentha	274	Nerium	307
Lotus	81	MENYANTHÆ	305	Nettle, Horse	301
Lousewort	264	Menyanthes	305	Nicandra	302
Love Apple	300	Menziesia	241	Nicotiana	300
Love-in-a-Mist	21	Mertensia	228	Nigella	21
Love Vine	289	Mikania	194	Nightshade, Beaked	302
Lucerne	105	Milfoil	221	Black	301
Ludwigia	149	Milkweed	809, 810, 811	Enchanter's	150

Nightshade, Woody	301	Peach Subfamily	118	Plum, Ground	108
Nightshade or Potato		Peanut	96	Plum Subfamily	118
Family	300	Hog	101	Podophyllum	80
Ninebark	126	Pear	118, 119	Poke	319
Nonesuch	105	Pear Subfamily	118	Indian	347
Nuphar	82	Pedicularis	264	Poke Berry	319
Nutmeg Flower	22	Pelargonium	68	Pokeweed	319
Nymphaea	31	Peltandra	323	Polanisia	47
NYMPHAEACEAE	30	Pencil Flower	95	Polar Plant	205
Nyssa	169	Pennyroyal	276	POLEMONIACEAE	296
		Bastard	273	Polemonium	296
		False	278	Pollanthes	327
Oak, Poison	87	Penthorum	144	Polyanthus	348
Oakesia	245	Pentstemon	258, 259	Polygala	88
Obolaria	205	Peony	24	POLYGALACEAE	67
Ocimum	272	Pepper and Salt	168	POLYGONACEAE	315
Oenothera	145	Peppergrass	45	Polygonatum	342
Okra	64	Pepperidge	169	Polygonella	315
Old Maid	308	Peppermint	274	Polygonum	316
Old Man	223	Pepperrut	40	Polymnia	304
OLEACEAE	311	Peppertwort	45	Polypetalous Plants 7, 14-170	
Olive Family	311	Perigloca	309	POMACEAE	113
ONAGRACEAE	146	Periwinkle	308	Pomme Blanche	106
Onosmodium	285	Persea	320	Pomme de Prairie	106
Opuntia	155	Perscaria	313	Pontederia	348
Orange Grass	59	Petaloidaeous Plants 19, 325-350		PONTEDERIACEAE	348
Orange Root	94	Petunia	308	Poor Man's Weatherglass	250
Origanum	272	Phacelia	292, 293	Poplar	96
Ornithogalum	339	<i>Pharbitis</i>	297	Poppy	35
Orontium	324	Phaseolus	100	California	36
Orpine	143	Phaseolus's Eye	52	Celandine	34
Orpine Family	142	Philadelphus	139	Mexican or Prickly	34
Osmanthus	313	Phlox	272	Plume	36
Osmorrhiza	161	Phryma	270	Poppy Family	33
Oswego Tea	279	Phyllocaetus	157	Portulaca	56
OXALIDACEAE	69	Physalis	302	PORTULACACEAE	56
Oxalis	69	Physocarpus	126	Potato	301
Oxeye	209	Physostegia	272	Potentilla	132
Oxlip	248	Phytolacca	319	Prairie Dock	205, 206
Oxyococcus	240	PHYTOLACACEAE	313	<i>Prenanthes</i>	234
Oxydendrum	243	Picea	332	Prickly Pear	156
		Pickelweed	348	Pride of India	74
Paeonia	94	Pickelweed Family	348	Pride of Ohio	248
Paint Brush, Indian	264	Pigeon Berry	319	Prim	315
Painted Cup	264	Pinpernel	250	Primrose	247, 248
Panax	166	PINACEAE	321	Prinula	247
Pancratium	327	Pinckneys	182	PRIMULACEAE	247
Pansy	51	Pine	321	Prince's Feather	315
Papaver	35	Pine Family	331	Prince's Pine	246
PAPAYERACEAE	38	Pine-sap	247	Privet	315
Papaw	27	Pineweed	59	Prosartes	335
PAPILIONACEAE	90, 91	Pingicula	265	Prunus	113
Pappoose Root	29	Pink	52	Psoralea	106
Parnassia	138	Fire	58	Ptelea	73
Parsley Family	156	Indian or Carolina	354	Pteropora	241
Parsnip	162	Indian	297	Puccoon, Hairy	288
Cow	162	Marsh	305	Hoary	288
Early Meadow	162	Moss or Ground	296	Red	34
Meadow	161	Mullein	54	Yellow	34
Parthenium	206	Rose	305	Pulsatilla	16
Partridge Berry	150	Pink Family	51	Pulse Family	59
Pasque Flower	16	Pinus	321	Pulse Subfamily	90
Passiflora	150	Pinxter Flower	244	Pumpkin	153
PASIFLORACEAE	150	Pipisewwa	246	Purslane	56
Passion Flower	150, 151	Plum	33	Water	149
Pastinaca	162	Pitcher Plant	33	Purslane Family	56
Paulownia	259	Pitcher-plant Family	32	Pycnanthemum	270
Pea		PLANTAGINACEAE	250	Pyrola	345
Beach	94	Plantago	251	Pyrola Subfamily	241
Everlasting	94	Plantain	251	Pyroleae	341
Hoary	108	Indian	225	Pyrrhopappus	235
Marsh	94	Robin's	199	Pyrus	118
Partridge	110	Pleurisy Root	311	Quamoclit	297
Sensitive	110	Plum	113, 114	Quamasia	239
Sweet	94			Quassia Family	73
Pea Subfamily	90				
Peach	115				

Queen of the Meadow	125	Sanicle, White	198	Snakeroot, White	198
Queen of the Prairie	125	Sanicula	160	Snapdragon	257
Quince	120	SAPINDACEÆ	82	Sneezeweed	218, 219
Radish	46	Saponaria	52	Snowball	176
Ragged Lady	21	Sarracenia	82	Japanese	176
Ragweed	207	SARRACENIACEÆ	82	Snowberry	171
Great	207	Sarsaparilla, Bristly	166	Snowdrop	328
Ragwort	226, 227	Wild	165	Soapberry Family	82
RANUNCULACEÆ	14	Sassafras	320	Soapwort	52
Ranunculus	18	Satin Flower	48	SOLANACEÆ	800
Raphanus	46	Satureia	272	Solanum	801
Raspberry	128, 129	Saxifraga	185	Solidago	300
Rattlesnake Master	159	SAXIFRAGACEÆ	184	Solomon's Seal	342, 343
Rattlesnake Root	284, 235	Saxifrage	185	Clustered	344
Rattlesnake Weed	234	Golden	186	False	343
Red Robin	68	SAXIFRAGEÆ	185	Two-leaved	344
Redbud	109	Scabiosa	185	Sonchus	237
Redroot	79	Scabious or Scabish	185	Sorbus	118
RHAMNACEÆ	78	Scabious, Sweet	185, 199	Sorrel	816
Rhamnus	78	Scarlet Runner	100	Sheep	816
Rheum	315	Schoenocaulon	346	Wood	69, 70
Rheumatism Root	29	Schrankia	111	Sorrel Tree	243
Rhododendron	248	Schweinitzia	241	Sourwood	248
Rhodora	241	Scleranthus	56	Southernwood	223
Rhus	86	Scoke	319	Spadiceous Plants	12, 322-324
Ribes	140	Scorpion Grass	298	Spanish Needles	216
RIBESIÆ	135	Scratch Grass	318	Spathyema	324
Ribgrass	251	Scrophularia	257	Spatter Dock	82
Ribwort	251	SCROPHULARIACEÆ	255	Spearmint	274
Richweed	276	Scutellaria	281	Specularia	239
Ripplegrass	251	Sedge Family	350	Speed well	261, 262
Robinia	108	Sedum	142	Spice Bush	320
Rock Rose	48	Seedbox	149	Spider Flower	47
Rock-rose Family	47	Self-heal	281	Spiderwort	349, 350
Rosa	121	Sempervivum	148	Spiderwort Family	349
ROSACEÆ	118	Senebiera	46	Spigella	254
Rose	121, 122	Serfecto	226	Spignet	166
Japan	60	Senna	110	Spikenard, American	166
Moss	57	Senna Subfamily	90	False	344
Rose Bay	248	Sensitive Brier	111	Small	165
Rose Family	113	Sensitive Plant	111	Spindle Tree	77
Rosmarinus	272	Sericocarpus	194	Spiraea	124
Rosin Plant	204	Service Berry	121	Spiraea	124, 125
Rosin Weed	204, 205	Shad Berry	121	Spoonwood	241
Rowan Tree	120	Shamrock	70, 108, 105	Sprekella	327
RUBIACEÆ	177	Sheepberry	176	Spring Beauty	57
Rubus	126	Shepherd's Purse	45	Spruce	322
Rudbeckia	210	Shin Leaf	245	Squash	158
Rue	72	Shooting Star	248	Crookneck	153
Rue Anemone, False	20	Sickle Pod	41	Squawweed	226
Ruellia	261	Sicyos	152	Squirrel Corn	87
Rumex	316	Sida	68	Stachys	288
Ruta	72	Side-saddle Flower	82	Staff Tree	77
Rutabaga	48	Silene	58	Stag Bush	176
RUTACEÆ	72	Silk Flower	112	Stapella	309
		Silk Tree	112	Staphylea	83
Sabbatia	305, 306	Silkweed	309	Star Flower	249
Sage	278, 279	Silphium	204	Star Grass	329
Wormwood	223	Silver-rod	201	Star of Bethlehem	340
Sagebrush	222, 223	Silverweed	183	Starwort	55, 194
Sagebush	223	SIMARUBACEÆ	73	Steeple Bush	124
Sagittaria	326	Sinapis	42, 43	Stelronema	250
St. Andrew's Cross	58	Sisymbrium	42	Stellaria	55
St. John's-wort	58	Sisyrinchium	331	Stenanthium	346
Marsh	59	Skullcap	281	Stephanotis	309
St. John's-wort Family	57	Skunk Cabbage	324	Stick-seed	290
St. Peter's-wort	58	Sloe	176	Stick-tights	217
St. Peter's Wreath	125	Smartweed	317	Stitchwort	55
Salad, Corn	184	SMILACEÆ	381	Stock	40
Salvia	278	Smilacina	348	Stonecrop	143, 143
SAMBUCEÆ	170	Smilax	381	Ditch	144
Sambucus	174	Smoke Tree	87	Virginia	144
Samolus	247	Snakehead	258	Stoneroot	276
Sanguinaria	84	Snakeroot, Black	24, 160	Stramonium	304
Sanicle	160	Button	190	Strangleweed	299
		Seneca	88	Strawberry	181

Strawberry, Barren or Dry	129	Tick Trefoil	96, 97	Viburnum	173
Strawberry Bush	77	Tickseed	214, 215	Viburnum, Downy	176
Strawberry Shrub	134	Tigridia	329	Sweet	176
Strawberry Tree	77	Tilia	65	Vicia	94
Streptopus	335	TILIACEÆ	65	Vinca	306
Stamp Tree	111	Toadflax	256	Vine Family	79
Stylophorum	34	Tobacco, Indian	233	VIOLACEÆ	48
Stylosanthes	95	Tobacco Root	134	Violet	49
Succory	232	Tofieldia	346	Viper's Bugloss	237
Sumac	86, 87	Tomato	300	Virginia Creeper	81
Chinese	74	Musk or Strawberry	302	Virgin's Bower	15
Sun Plant	57	Toothache Tree	73	VITACEÆ	79
Sundew	144	Toothwort	40	Vitis	80
Sundrops	143	Torreya	323	Wahoo	77
Sunflower	211, 212, 218	Touch-me-not	71	Waldsteinia	129
False	209	Tournefortia	256	Wall Pepper	143
Swamp	219	Trachelospermum	307	Wallflower	41
Supple-jack	79	Tradescantia	349	Watches	33
Sweet Cicely	161	Trailing Arbutus	242	Water Carpet	136
Sweet Flag	325	Tree of Heaven	74	Water Cress	89
Sweet Pepper Bush	245	Trefoil	103	Water-lily Family	30
Sweet Sultan	229	Shrubby	73	Water Pepper	317
Sweet William	52	Trichostema	273	Water Plantain	326
Wild	294	Trifolium	103	Water Willow	268
Sweetbrier	122	Trifolia	192	Waterleaf	291
Sweet-scented Shrub	134	TRILLIACEÆ	332, 333, 334	Watermelon	154
Symphoricarpos	171	Trillium	332, 333, 334	Waxberry	171
Symphytum	285	Triosteum	171	Waxwork	77
Symplocarpus	324	TROPEOLACEÆ	71	Wayfaring Tree	175
Synandra	272	Tropæolum	72	English	177
Syringa	318	Trumpet Creeper	252	Weigella	173, 174
False	139	Trumpet Flower	252	Wheat Thief	237
Tendrilled	252	Tendrilled	252	Whitewood	221
Tagetes	227	Trumpet Leaf	33	Whitewood	24, 66
Tanacetum	222	Tuga	322	Whitlavia	299
Tansy	222	TURBIFLOREÆ	157	Whitlow Grass	44
Goose	133	Tulip	336	Wicky	242
Taraxacum	235	Tulip Tree	26	Widow's Cross	143
Tare	94, 95	Tulipa	336	Wild Potato Vine	298
Tassel Flower	226	Tupelo	169	Willow-herb	147
TAXACEÆ	322	Turmeric Root	24	Windflower	16
Taxodium	322	Turnip	43	Winterberry	76
Taxus	322	Indian	323	Wintergreen, Creeping	243
Tea, Appalachian	176	Prairie	106	Chickweed	249
Blue Mountain	202	Turtlehead	258	Flowering	88
New Jersey	79	Twin Berry	180	Spotted	244
Tea Family	60	Twin Flower	170	Wistaria	99
Tea Rose	60	Twin Leaf	29	Witch-hazel	144
Teaberry	243	UNREKLIFERÆ	158	Withe-rod	176
Tear-thumb	318	Umbrella Tree	26	Wolfberry	172
Teasel	185	Utricularia	266	Wolfsbane	33
Tecoma	252	Uvularia	344	Wood Sage	273
Telegraph Plant	97	Vaccinies	240	Woodbine	172, 173
Ten-weeks Stock	40	Vaccinium	240	Wormwood	232, 233
Tephrosia	108	Valerian	184	Roman	207
TERNSTROMIACEÆ	60	Valeriana	184	Woundwort	233, 234
Tetragonotheca	209	VALERIANACEÆ	183	Xanthium	207
Teucrium	272	Valerianella	184	Xanthoxylum	72
Thalictrum	17	Vanilla Plant	192	Xerophyllum	346
Thlaspium	161	Velvet Leaf	63	Yarrow	221
Thimbleweed	16	Venus's Flytrap	145	Yaupon	76
Thistle	230, 231	Venus's Looking-glass	239, 240	Yellow Root	24
Sow	237	Veratrum	347	Yellowseed	45
Star	229	Verbascum	255	Yellowwood	93
Thorn	116, 117, 118	Verbena	269, 270	Yew, Dwarf	322
Thorn Apple	304	VERBENACEÆ	213	Yew Subfamily	323
Thoroughwax	160	Verbesina	213	Youth and Old Age	206
Thoroughwort	193	Vernonia	189	Yucca	341
Three Birds	257	Veronica	261	Zephyranthes	333
Thuja	322	Vervain	269, 270	Zigadenus	346
Thunbergia	268	Vetch	94, 95	Zinnia	305
Thyme, Basil	278			Zizia	103
Virginia	277				
Thymus	277				
Thysanella	315				
Tiarella	136				

